Harris Cares

A 2020 Vision
of Health in Harris County

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Acknowledgements

We wish to express our sincere appreciation to the following for their support and contributions to this countywide study:

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Acknowledgements

We wish to express our sincere appreciation to the following for their support and contributions to this countywide study:

CONSULTANTS

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SPECIAL THANKS TO:

John Auerbach,
Dr. Georges Benjamin, and
Megan Snair for their contributions to this work.

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https://publichealth.harriscountytx.gov

SUGGESTED CITATION

Harris County Public Health (HCPH) Harris Cares: A 2020 Vision of Health in Harris County (TX), November 2019.

THANK YOU HEALTH STUDY PARTNERS

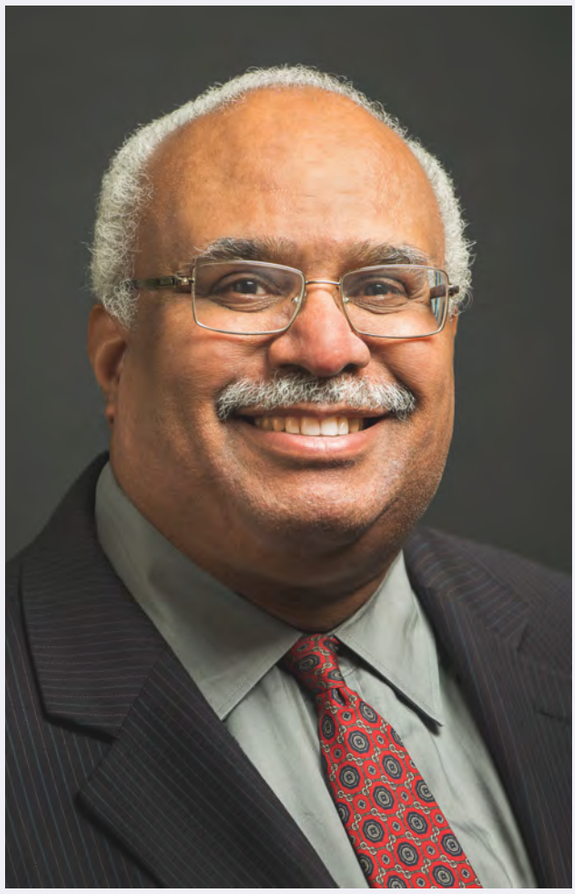
While not an exhaustive list, the authors would like to thank the following partners who were extremely helpful in providing the input, feedback, and subject matter expertise for this study to be possible.

AARP
AIDS Foundation Houston, Inc.
Air Alliance Houston
Altus Healthcare Management
American Heart Association
American Leadership Forum: Houston/Gulf Coast
American Public Health Association
American Red Cross
Archway Academy
Area EMS and Medical Directors (37 Agencies)
Arizona State University
Asian American Health Coalition of Greater Houston
Avenue 360 Health and Wellness Avenue CDC
Baker Institute for Public Policy
BakerRipley
Bay Area Houston Economic Partnership
Baylor College of Medicine
Baylor Teen Clinic
Best Friends Animal Society Houston
Bike Houston
Blue Cross and Blue Shield of Texas
Brazoria County Health Department
Brighter Bites
Brown Foundation
Casa El Buen Samaritano
Centers for Disease Control & Prevention
CHI St. Luke's Health
Children at Risk
CHRISTUS Foundation for Healthcare
Citizens' Environmental Coalition
Community Health Choice
Deer Park Chamber of Commerce
DePelchin Children's Center
Dia de la Mujer Latina
Diversity in Democracy, LLC
Doctors for Change
El Centro de Corazón
Episcopal Health Foundation
Esri
First Texas Hospital
Fort Bend County Health and Human Services
Galveston County Health District
Greater Houston Black Chamber of Commerce
Greater Houston Community Foundation
Greater Houston Partnership
Greater Houston Restaurant Association
Harris Center for Mental Health and IDD
Harris County Budget Management Department
Harris County Community Services Department
Harris County Attorney's Office
Harris County Department of Education
Harris County Engineering
Harris County Fire Marshal's Office
Harris County Flood Control District
Harris County Human Resources & Risk Management
Harris County Institute of Forensic Sciences
Harris County Judge's Office
Harris County Medical Society
Harris County Office of Homeland Security and Emergency Management

Harris County Office of Legislative Relations
Harris County Pollution Control Services
Harris County Precinct 1 Commissioner's Office
Harris County Precinct 2 Commissioner's Office
Harris County Precinct 3 Commissioner's Office
Harris County Precinct 4 Commissioner's Office
Harris County Protective Services for Children and Adults
Harris County Public Library
Harris County Sheriff's Office
Harris County Toll Road Authority
Harris County Universal Services
Harris Health System
HCA Gulf Coast
HCA North Cypress
HCC Coleman College of Health Sciences
Healthcare for the Homeless -Houston
Healthy Futures of Texas
Hogg Foundation for Mental Health
HOPE Clinic
Houston Center of HOPE
Houston East End Chamber of Commerce
Houston Endowment
Houston Food Bank
Houston Health Department
Houston Hispanic Chamber of Commerce
Houston Immigration Legal Services Collaborative
Houston Local Initiatives Support Corporation
Houston Methodist
Houston Northwest Chamber of Commerce
Houston PetSet
Houston Recovery Center
Houston-Galveston Area Council
Ibn Sina Foundation
Indo American Chamber of Commerce
Institute for Spirituality and Health at the Texas Medical Center
Interfaith Ministries for Greater Houston
Islamic Society of Greater Houston
January Advisors
Kelsey-Seybold Clinic
Kinder Institute for Urban Research
Legacy Community Health
Lone Star Legal Aid
Memorial Hermann Health System
Mental Health America of Greater Houston
Michael E. DeBakey VA Medical Center
Microsoft Research
Montrose Center
mySidewalk
National Association of County and City Health Officials
National Association for the Advancement of Colored People, Houston Branch
National Alliance to Impact Social Determinants of Health
National Environmental Health Association National Network of Public Health Institutes
National School of Tropical Medicine – Baylor College of Medicine
Network for Public Health Law
Network of Behavioral Health Providers
Pasadena Health Center
Planned Parenthood Gulf Coast
Prism Health North Texas
Public Citizen
Public Health – Seattle/King County
Rice University
Robert Wood Johnson Foundation
Rockwell Fund, Inc.
San Jacinto College
San Jose Clinic
South Asian Chamber of Commerce
Southeast Texas Regional Advisory Council
Spring Branch Community Health Center
St. Hope Foundation
Texas A&M University
Texas Association of City and County Health Officials
Texas Children's Hospital
Texas Commission on Environmental Quality
Texas Department of State Health Services (DSHS)
Texas DSHS Region 6/5 South
Texas Environmental Justice Advocacy Services
Texas Health and Environment Alliance
Texas Health and Human Services Commission
Texas Health Institute
Texas Medical Association
Texas Medical Center Policy Institute
Texas Organizing Project
Texas Public Health Association
Texas Public Health Coalition
Texas Restaurant Association
Texas Southern University
The Immunization Partnership
The Menninger Clinic
The Simmons Foundation
The Texas International Institute of Health Professions
Trust for America's Health
United Healthcare
United Way of Greater Houston
University of Houston-Clear Lake
University of Houston-College of Medicine
University of Houston-Law Center
University of St. Thomas
The University of Texas MD Anderson Cancer Center
The University of Texas Health Science Center
The University of Texas School of Public Health
UTMB Health
UTPhysicians
Vecino Health Centers
Wild Blue Health Solutions

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Foreword



The American Public Health Association (APHA) believes deeply in the value of health promotion and disease prevention and strongly supports the use of clinical, rehabilitative and habilitative care to restore health. Yet 80% of what makes us healthy occurs outside the clinician's office. This means we must address the societal factors that influence our health. That can only happen if community leaders and policymakers join with us in an honest discussion about how best to move from health care to health. As a society, we all have an ability to improve the quality of life in our respective communities.

How do we move toward better community health? APHA promotes the concept that communities can take control over their health using a multisectoral assessment, joint planning and coordinated implementation. We believe such an approach, if taken across the country, will help make America be among the world's healthiest nations. We have worked with several national organizations to measure the impact of this approach and have found great success. In the field of public health, it has long been known that collaborative partnerships to improve health are a strong force that creates innovative and sustainable change resulting in a positive impact on the health of the community. By engaging and activating bold leadership from government, health care, business, education, law enforcement, faith communities and many other sectors, individual and population health become an expected community value.

And that's where public health comes in. When used effectively, the three core functions of public health (assessment, policy development and assurance) form a framework that serves as the basis for improving the health of a community. Further, when a cross-sector approach is used that engages the community and its leaders; this framework creates a powerful tool for health improvement. This report entitled "Harris Cares" is one such tool. It provides a powerful inventory of the strengths and weakness of the health of the people of Harris County and offers a clear roadmap for health improvement.

The context of this report is vital because it embraces innovative approaches to transform entire populations, built on a framework that promises to reinvigorate change for the residents of Harris County. The work done by the Harris County Public Health - supported by the leadership of Harris County Commissioners - is an important step not only toward making substantive improvements in overall community health but also to address the structural conditions that drive health disparities.

The ultimate goal is to have Harris County become among the healthiest counties in America. This report is an actionable resource that identifies both gaps and solutions to move the needle forward. It affords your community leaders in all sectors meaningful guidance that if followed, will improve the health of the people of Harris County.

"The context of this report is vital because it embraces innovative approaches to transform entire populations, built on a framework that promises to reinvigorate change for the residents of Harris County."

A Message from the Executive Director for Harris County Public Health

"...it's not too late for the countless others who struggle navigating an often broken health care system."



On behalf of Harris County Public Health (HCPH), I am pleased to present this milestone assessment of health in Harris County, *"Harris Cares: A 2020 Vision of Health in Harris County."* In this study, HCPH evaluates where the nation's third largest county stands with respect to health and presents a road map to a healthy future.

In the beginning of 2019, Harris County Commissioners Court tasked HCPH with reviewing public health and prevention for our community. The scope was later expanded to include healthcare delivery. To meet this scope, our team analyzed and interpreted national, state, and local data; surveyed countless stakeholders; reviewed models of care and innovation from elsewhere; and most importantly, gathered and illuminated the voices of those who matter most – our community.

Though we could have spent years on this topic given the complexity of health in a community this large, we make the case for change through five *Transformational Recommendations* (*T-Recs* for short) intended to advance health over the next decade. While our department's cornerstone values of innovation, engagement, and equity are infused throughout, we recognize moving forward will require a collective spirit and action. All recommendations are for county leadership to consider. Some will require minimal action to implement; others will require future planning and investment.

People struggle with health daily, whether it is their own health or that of their loved ones. As a physician having worked twenty years in the health care system, I am acutely aware of these challenges. I witnessed them equally while navigating the system on behalf of my own family, especially my father who passed away in 2018. Sadly, the health care system could not solve his concerns alone. Instead, they required a more holistic approach: integrating health and social connectedness. In the end, it was not just about him but rather everything around him. While it is too late for him, it is not too late for the countless others who struggle navigating an often-broken health care system.

In the end, strategic investments "upstream" in prevention are our best hope.

Let me close by thanking Harris County Judge Lina Hidalgo and each member of Commissioners Court for supporting our efforts. Gratitude also to our countless partners who shared in this journey. While we will be the first to admit this report is far from perfect, your input has been instrumental and hope this report assists you as well. Finally, I would be remiss if I did not thank our wonderful project team who joined us in giving their very all, day and night, weekends, moving schedules and planned activities to accommodate. Simply put, this could not have been done without them – absolutely the best team around!

We know this study will never solve the issue of health by itself. It is only the beginning of the journey. It will be left to all of us to envision that future with clarity and to work together today so we can all enjoy a healthier Harris County tomorrow.

Sincerely,



Umair A. Shah, MD, MPH
Executive Director and Local Health Authority
Harris County Public Health

Executive Summary

This health study, entitled *Harris Cares*, offers a view into the future of health in Harris County for 2020 and beyond. The study is split into three main sections: *Transforming Health in Harris County, Building Resilience in Harris County, and a Snapshot of Health in Harris County*.

The content of this study is based on years of community input, data on health and factors that affect health available at the local, state, and federal levels, and the direct input of over one hundred institutions that affect health where we live, learn, work, worship, and play.

Transforming Health in Harris County requires an understanding of the intersections of health care delivery and public health. Many residents experience significant barriers to accessing health care. These have been major barriers within "three A's of Access: availability, acceptability, and affordability." To achieve better health outcomes, like the decrease of uncontrolled chronic disease across a community, multiple partners and increased coordination are needed. The costs of health care, through preventable hospitalizations and emergency department utilization for chronic disease is extraordinarily high, resulting in a need to invest in preventive services for all Harris County residents. Ignoring preventive services upstream is a substantial factor of the high costs to the local health system and therefore county.

Although increased coordination in health care will improve health, it is limited in capacity to the number of residents served. **Simply put, a community cannot diagnose, treat, or medicate its way back to good health for problems such as widespread obesity, diabetes, asthma, and poor mental health.** Solutions instead lie in better coordination among nontraditional health partners such as social services and infrastructure, better clarification of jurisdiction and governance, and increased alignment and sharing of data across public and private partners.



Building Resilience in Harris County requires building the capacity of communities to prepare for, withstand, mitigate the effects of, and recover from emergency utilizing a health equity perspective. Resilience in a community to bounce back from the emergencies that plague Harris County is especially critical. There never seems to be a dull moment from hurricanes, disease outbreaks, fires, derailments, and more. Poor health outcomes exist disproportionately across the Harris County community, with the consequence being an unequal distribution of opportunity for good health. These risks and factors require a collective impact and collaboration, especially in county government. Expected quality of life and life expectancy vary across communities residing a few miles from each other. The estimated longevity shows as much as 23.4 years difference in these neighboring areas.

A Snapshot of Health in Harris County can generate data driven insight into the burden of chronic diseases, injuries, infectious diseases, and more that greatly impact the health of all residents in Harris County. To transform health, shared goals across government and private partners should include the evaluation of existing data as a way of measuring the county's success and outcomes over the next decade. Harris County cares about the health of all its residents and should invest in and support new opportunities for innovation and transformation.



Transformational Recommendations

1.

Drive systems-level change through prevention and upstream focused solutions that incorporate health and social services in a more integrated and effective manner.

Health is holistic, complex, and multidisciplinary in nature. One's zip code is a better predictor of health than one's genetic code, so to achieve better health at the population level, solutions must be directed at the systems level. Governance, prioritization, and coordination of county resources should advance the health of all residents.

1.1. Create a culture of health through investments in "upstream" or public health prevention approaches that target the social determinants of health (education, economic empowerment, housing, access to fresh foods, transportation, safe places to engage in physical activity, etc.) to mitigate more "downstream" or expensive health care costs to the system and make health a shared value of Harris County.

1.2. Create a countywide health-related initiative (through a formal governance structure such as a health coordinating council) that includes multidisciplinary department and stakeholder representatives with the objectives of improving community health and resilience and fostering cross-sector collaboration.

1.3. Identify countywide infrastructure projects (flood mitigation, housing, roads, parks, etc.) that would benefit from broad multidisciplinary teams in planning, implementation, and opportunities for optimizing community health impact and creating healthier, more equitable communities.

1.4. Support efforts to integrate Health Impact Assessments and other similar health reviews in the planning and implementation phases of countywide infrastructure projects, and partner with entities in academia, faith-based institutions, nonprofits, and other stakeholder groups to implement healthier options that improve population health and well-being.

2.

Coordinate delivery of existing health care services to ensure efficiency and effectiveness and develop new health care infrastructure in higher need areas to improve access to health care across the community.

Access to health care continues to be a barrier as noted by residents and by data in this study. Investment into both "brick and mortar" infrastructure and rapidly deployable, flexible alternatives to care can increase the availability of resources, especially in times of an emergency. While health care infrastructure investment cannot change health outcomes of communities within Harris County alone, it is an important element for ensuring provision of health care delivery within these very communities.

2.1. Conduct a feasibility study on the investment in large-scale health care delivery infrastructure such as anchor hospital(s), etc. where there are federally designated MUAs, demonstrable lack of health care access, and where there is a high risk for large scale, industrial public health emergencies (train derailments, chemical fires, plant explosions, etc.).

2.2. Enhance existing or create additional community clinics that focus on preventive services and are co-located with public health, mental health, and social services. This access to preventive services can divert unnecessary emergency department visits that are especially critical during an emergency.

2.3. Invest into leaner, versatile alternatives to "brick and mortar health" care infrastructure, including mobile health vehicles, telehealth, and other innovative technologies, which can also be rapidly deployed during an emergency event. These resources can address the needs of areas with low population density.

2.4. Expand access to specialty care such as dialysis and mental health resources in a way that builds resilience before, during, and after emergencies and is equitable in times when there is no emergency.

3.

Enhance the safety net system to better address the ongoing health needs of Harris County residents who are under- or uninsured, including through the creation of a new, robust delivery model called "Harris Care."

Availability, acceptability, and affordability continue to be significant barriers to accessing health care equitably within Harris County. Financing of uncompensated care is a significant driver in overall health care system costs. County government can play a key role in developing innovative methods of delivering or paying for care. Such methods can in turn incentivize positive population health outcomes to position the safety net system to be more resilient to shifting health care policy at the state and federal levels.

3.1. Advocate with local, state, and federal partners for key policy changes including Medicaid expansion, 1115 Waiver renewal, and explore requesting a 1332 Waiver through the state to increase the number of eligible Harris County residents for health insurance coverage.

3.2. Examine the potential impact and cost/benefit of creating a new, locally driven delivery model called "Harris Care," a local health care funding mechanism that would ensure access to low or no-cost primary and preventive care services for the uninsured population through enhanced coordination of existing and future infrastructure/programs designed to address their identified needs.

3.3. Explore a feasibility study to scale up existing programs or create new programs adopted from the best practices and strategies utilized in other communities —whether across the nation or globally—to address the health care needs of populations who are otherwise unable to afford or are ineligible for private insurance, Medicaid, Children's Health Insurance Plan, other government programs, etc.

3.4. Conduct a countywide awareness campaign for community members and health care providers alike on updates associated with changing state and federal rules on enrollment and eligibility, including public charge, that identifies resources and legal assistance available to address identified concerns and advance health equity.

4.

Align strategies across county and municipal governmental departments that impact health to improve coordination, collaboration, and communication.

Governmental agencies within Harris County serve the same population, yet their specific strategic direction and goals are not always aligned. To most effectively and efficiently drive change for the community, there needs to be improved strategic alignment amongst these agencies—as well as their counterparts that may exist in the 34 municipalities within Harris County—to address the complex drivers of health and resiliency.

4.1. Conduct a systematic review of existing grants, programs, and services of county departments and subsequently their counterpart departments in other municipalities to identify overlap and potential collaboration between and amongst various departments, whether their charge and responsibilities are directly or indirectly health-related.

4.2. Improve data and information-sharing procedures and policies to evaluate and track progress of countywide health initiatives meant to address preventable hospitalizations, chronic disease prevalence, and other population health metrics.

4.3. Encourage local health systems to conduct joint community health needs assessments to align agency missions, visions, and strategic plans, especially the four local and publicly financed governmental health systems: Harris Health System, Harris Center for Mental Health and Intellectual and Developmental Disabilities, Harris County Public Health, and Houston Health Department.

4.4. Where feasible, align parallel Harris County and City of Houston policies and procedures for matching services, programs, and eligibility requirements, especially during an emergency, to prevent resident confusion.

5.

Streamline and integrate health care and prevention services across Harris County and, where feasible, the City of Houston.

Multiple government agencies work to make Harris County a healthy community. However, significant silos still exist among these agencies. There lacks a unified overall strategy to improve health. Residents find it difficult to navigate the system and to identify and access all of the available services. With the current fragmented system, accountability for health improvement is blurred. Identifying and eliminating inefficiencies in health-related activities can and will help streamline areas of service overlap.

5.1. Convene a task force to oversee an in-depth and independent review of health and social services delivered throughout Harris County across local government agencies, including in public health, mental health, safety net providers, etc., as already explored in previous community assessment reports such as the 2004 Greater Houston Partnership's Public Health Task Force Report, the 2017 City of Houston's Ten Year Plan, and others.[2,3,4]

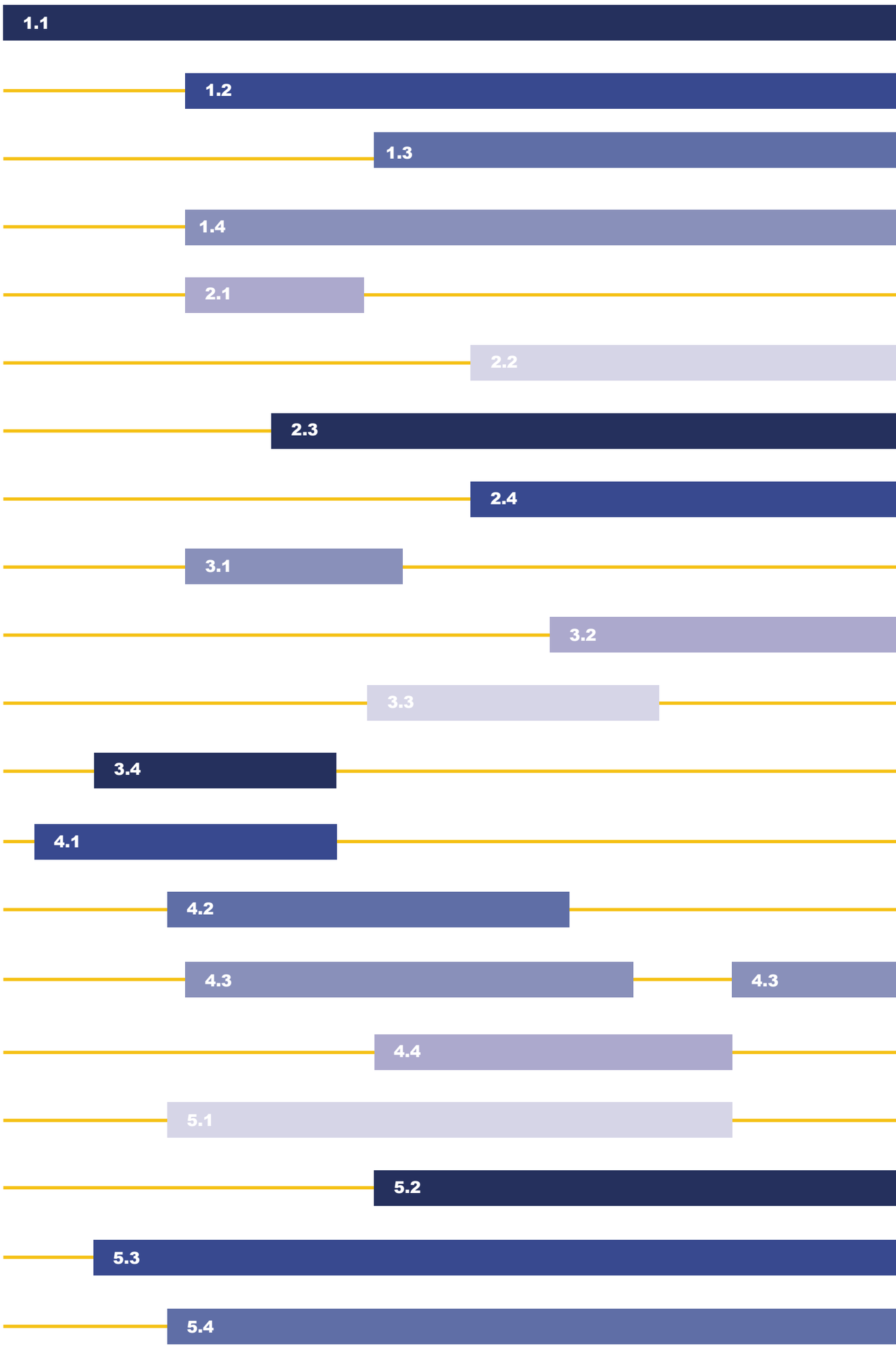
5.2. Identify and eliminate duplicative administrative and technical resources by modifying areas of service overlap, including between Harris County and other health departments within municipalities, as well as identify opportunities to present unified data, outcomes measures, and service delivery, etc.

5.3. Improve systems interoperability to automate critical data sharing necessary both for day-to-day situations and during community responses for public health emergencies, including chemical, biological, radiological, and other emergencies.

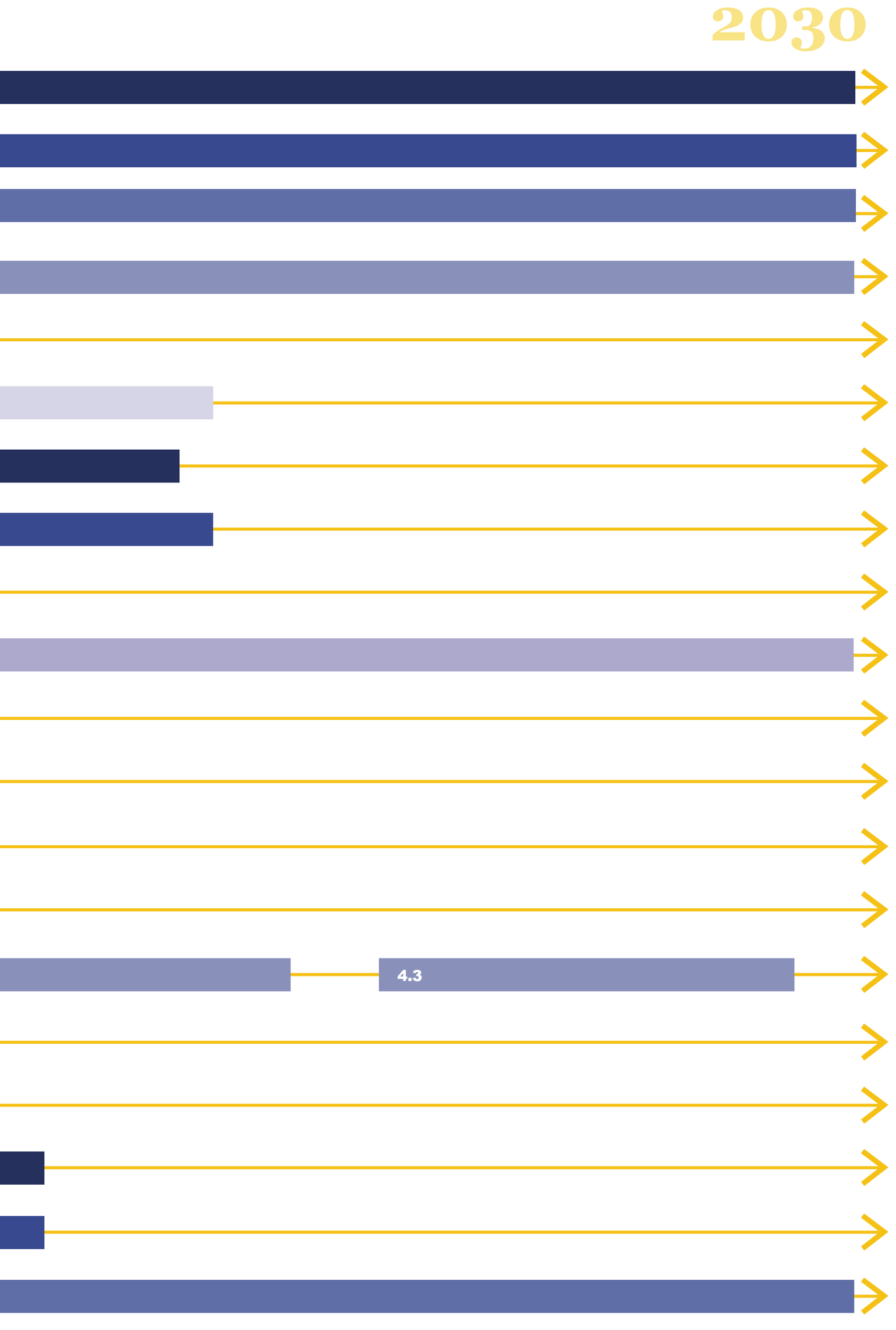
5.4. Create a new Harris County Office of Health Integration and Outcomes that can guide integration of duplicative programs, services, and even departments that have an impact on health as well as oversee improvements in key health outcomes laid out in this study and beyond.



2020



Harris County Proposed Timeline


2030
4.3

Section 1:

TRANSFORMING HEALTH IN HARRIS COUNTY



Chapter 1: Introduction and Background

Chapter 2: Public Health and Health Care

Chapter 3: Health Care Access and Delivery

Chapter 4: The Business Case for Transforming Health

Chapter 5: Voices Heard By HCPH

Chapter 6: Transforming Health: Recommendations





"Good data and comprehensive assessments are step one and two for thinking through solutions for complex health challenges."

—Dr. Eduardo Sanchez
Chief Medical Officer, American Heart Association
Former Texas Department of State Health Services Commissioner

1

Introduction and Background

Health and well-being are important to residents and the communities in which they live. The World Health Organization (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[5] Through this definition, the WHO makes it clear: good health requires more than physical care. This implies that there must be integration and coordination of care by health care professionals, mental health specialists, and social workers to ensure the health of the whole individual.

By extension of the WHO definition, a healthy community is a population with complete physical, mental, and social well-being. In other words, a strong system of health requires more than hospitals and clinics. There must be integration and coordination among health care, mental health, social institutions, and public health — each playing a key role as part of the overall assurance of good health.

With over 4.7 million residents, Harris County is the most populous county in Texas and the third largest in the United States. Harris County is divided into four precincts, each overseen by an elected commissioner (Figure 1.1). A county judge is elected to represent the entire county. These leadership positions constitute the Harris County Commissioners Court, which is responsible for overseeing county agencies, including health-related entities such as Harris Health System (Harris Health), The Harris Center for Mental Health and Intellectual and Developmental Disabilities (Harris Center), and Harris County Public Health (HCPH), respectively. Harris County Commissioners Court also has governance over multiple other non-health county agencies and services that have indirect impact on health even though their main focus may be on infrastructure, flood mitigation, housing, etc. In addition, the City of Houston operates the Houston Health Department (HHD), which provides public health services within the city limits.



Introduction & Background

A bit more about these partners in the words of the partners themselves:

Harris Health celebrates more than 53 years of championing better health for patients, their families, and the community. This connects them to high-quality health care services with a focus on primary care, wellness, and prevention through its network of 47 clinics, health centers, specialty locations, and hospitals. Harris Health is a proud recipient of the prestigious National Committee for Quality Assurance designation for its patient-centered medical homes. Harris Health is staffed by nationally recognized physician faculty and residents from its medical school partners: Baylor College of Medicine; McGovern Medical School at The University of Texas Health Science Center at Houston (UTHealth); and The University of Texas MD Anderson Cancer Center.

The Harris Center works to transform the lives of people living with behavioral health and intellectual and developmental disabilities. This empowers them to improve their lives through an accessible, integrated, and comprehensive recovery-oriented system of care. Through a vast array of services designed to treat the whole person within a warm and caring environment, the Harris Center provides the highest level of quality and integrated care, successfully navigating the complexities of each individual. This nurtures them along the way and, ultimately, transforms lives.



HCPH is responsible for the provision of comprehensive public health services to Harris County residents. Achieving national accreditation in 2018, HCPH aims to improve the health and well-being of Harris County residents and the communities in which they live, learn, work, worship, and play and does so through its cornerstone values of innovation, engagement, and equity. These values led the National Association of County and City Health Officials (NACCHO), representing the nearly 3,000 local health departments (LHDs) across the nation, to recognize HCPH with its Local Health Department of the Year award in 2016. While HCPH's jurisdiction includes all the unincorporated areas of Harris County, it also provides public health services in some form to most of the 34 municipalities within Harris County, the largest of which is the City of Houston with 2.3 million people. In total, Harris County serves the 4.7 million residents in the county.

HHD works in partnership with the community to promote and protect the health and social well-being of Houstonians and the environment in which they live. HHD is a full-service health department that not only performs all core functions of a public health department but also many enhanced functions including initiatives to address health inequities. HHD services benefit all Houston residents but the department also takes additional steps to support those most in need, such as low-income mothers and children, older persons, and minority populations. Most HHD functions serve the 2.3 million residents of the City of Houston but the scope and impact extend into Harris County's population of 4.7 million people through the department's Area Agency on Aging, Bureau of Youth and Adolescent Health, Project Saving Smiles, See to Succeed, immunization strategies, syndromic surveillance, and HIV-STD surveillance. HHD's laboratory also services a 17-county region.

"To ensure clinical and public health services are available to all residents, Harris County should consider innovative and sustainable approaches to the root causes of health issues."

The above agencies are fully committed to comprehensive, integrated care to improve the health of all Harris County residents. **Harris County is fortunate to have such a strong group of publicly funded, health-focused agencies** that have all been recognized nationally and state-wide for their leadership, their work, and their commitment to the health and well-being of Harris County residents. They have partnered with each other to accomplish various health-related goals. Yet much more could be done to establish a strong foundation for advancing health goals in Harris County and achieving health equity for all residents of the county.



County government is the functional arm of state government and delivers many state services at the local level. Texas has 254 counties, each divided into four precincts. In Harris County, there are four elected precinct commissioners, along with an elected county judge – Judge Lina Hidalgo who was elected to this role in 2018. All five elected officials serve as members of Harris County Commissioners Court.

Precinct 1

Precinct 1 has an estimated population of 1.1 million, encompasses nearly 360 square miles of central and south regions of Harris County, and covers a substantial portion of Downtown Houston. Notable landmarks include the Texas Medical Center (TMC), major universities (University of Houston, Texas Southern University, Rice, St. Thomas etc.) and sports stadiums (BBVA Compass, Minute Maid Park, NRG Stadium, and Toyota Center, etc.). Precinct 1 is represented by Commissioner Rodney Ellis who was elected to this role in 2017.

Precinct 2

Precinct 2 has an estimated population of 1.0 million and encompasses nearly 560 square miles of east Harris County spanning from Huffman, to Webster, to Baytown, and East Aldine. Precinct 2 includes a number of access points to open water, as well as the only free public beach in Harris County – Sylvan Beach Park. It is also home to Lyndon B. Johnson Space Center, the Ship Channel, and San Jacinto Battleground. Precinct 2 is represented by Commissioner Adrian Garcia who was elected to this role in 2018.

Precinct 3

Precinct 3 has an estimated population of 1.2 million and encompasses over 453 square miles in size with 306 square miles in the unincorporated areas of west Harris County. Precinct 3 includes parts of the City of Katy, Bellaire, West University Place, Houston, Piney Point Village, Spring Valley, Hedwig Village, Bunker Hill Village, and Hunter's Creek Village. Precinct 3 parks cover over 15,000 acres, the most of any other Harris County precinct. Precinct 3 is represented by Commissioner Steve Radack who was elected to this role in 1988.

Precinct 4

Precinct 4 has an estimated population of 1.1 million, encompasses over 390 square miles, and is located in the North Central region of Harris County. It includes parts of the Houston area, Cypress, Humble, Kirby District, Klein, Memorial, North Harris, Norwest Harris, River Oaks, Spring, Spring Branch, and Tomball. Precinct 4 boasts several nature reserves and green space and has 41 designated historical sites. Precinct 4 is represented by Commissioner R. Jack Cagle who was elected to this role in 2011.

Purpose and Scope

In January 2019, HCPH respectfully requested that the Harris County Commissioners Court support a comprehensive countywide health study with a particular focus on public health within the community. In March 2019, Harris County Commissioners Court expanded the scope of the study from reviewing public health efforts within Harris County to include the county's health care system and provision of care so gaps and opportunities for improvement could be identified. This report was approved to be presented to Harris County Commissioners Court in November 2019.

It is well known that the fields of health care delivery and public health are inherently connected, with often the most efficient models acknowledging the interconnection between medical care and public health. In this study, HCPH has been charged with laying the groundwork for identifying current health issues and future plans as well as actions that can potentially be supported by Harris County Commissioners Court or other key stakeholders to improve health outcomes of all communities within Harris County. This includes the strengthening of health care delivery and public health infrastructure that can address the root causes of poor health within a community. Given the amount of dollars expended on health-related activities within Harris County, the focus is on those strategies that will improve the efficiencies of the system and those that will result in a positive return on investment (ROI) to the county and taxpayer. Truly this is an investment in not just health but also the Harris County community's well-being and vitality. This includes the community's value proposition of health and prevention as well as what it would take to improve on the system's success.

Poor health outcomes exist disproportionately across the Harris County community and are influenced by unequal distribution of opportunity for good health.

As a nationally and locally recognized leader in public health, HCPH is positioned to take on the county government's role as a "community health strategist" for Harris County and serve as the backbone agency to convene partners in the public health and health care sectors.[6] This study makes a number of recommendations to improve these partnerships and demonstrate how HCPH can help coordinate these programs and activities with the overall goal of improving the community's health and well-being.

Throughout the United States, communities have equally explored ways to improve on the value proposition of health, measured in both health and financial outcomes, by improving and enhancing their "safety net" system through new coverage models for those in most need of government services. This study will explore several such programs, such as *Access NYC* (New York City's program to provide low- or no-cost health insurance to all its residents), as well as *Healthy San Francisco,* and *My Health LA*, which offer similar programs to residents in San Francisco and Los Angeles, respectively.

These and other programs in other communities have shown meaningful success at ensuring the most disproportionately impacted of a community's population (those with limited access to health insurance or those simply without it) can receive primary and preventive health care. These programs could provide models for Harris County to adopt and adapt to better serve the needs of the community. This study also explores other communities that are implementing innovative, engaging, and equitable public health and health care partnerships that improve population health through new governance and systems change frameworks.

Roadmap

This study is split into three main sections: *Transforming Health in Harris County, Building Resilience in Harris County*, and a *Snapshot of Health in Harris County*.

Transforming Health in Harris County offers data and insight into existing public health and health infrastructure and five transformational recommendations to better health outcomes at a population level.

Building Resilience in Harris County explores an in-depth understanding of community infrastructure and external factors that influence health outcomes. Poor health outcomes exist disproportionately across the Harris County community and are influenced by unequal distribution of opportunity for good health. These risks and factors require collective impact and collaboration across fields of study and expertise, especially in county government.



"We need to start talking about health, not just health care, and invest in the things that improve health outcomes, which generally are outside of health care."

—Elena Marks, President and CEO, Episcopal Health Foundation

"The study's deep dive into community health outcomes data provides health officials with meaningful indicators to measure and evaluate the impact of any future countywide health initiative."

To set shared goals of improving health, it is important to capture a *Snapshot of Health* in Harris County. This section offers data and insight on existing health outcomes at the population level, and it points towards opportunity for greater collaboration and change.

Methods Used in this Study

This study has produced hundreds of maps and charts to ground its insights and recommendations in data. The study's deep dive into community health outcomes data provides health officials with meaningful indicators to measure and evaluate the impact of any future countywide health initiative. This study is informed by feedback from over 100 leaders from local, state, and national partners, who shared their strategies to improve the health of Harris County. These experts in multiple domains helped contextualize the data and provided suggestions on next steps. Lastly, the authors listened to the personal stories from dozens of residents who have experienced difficulties in achieving optimal health.

The countywide health study team used a mixed-methods approach to examine the health and well-being of Harris County residents. The process included:

1. **Primary data collection and analysis of quantitative and qualitative data**. This includes data reported to and directly collected by HCPH; results from surveys and investigations conducted by HCPH. Some examples include the Community Assessment for Public Health Emergency Response (CASPER) surveys; investigations of notifiable infectious disease reports; and data collected during program implementation.

2. **Analysis of existing or secondary datasets for Harris County.** This includes databases and survey data from government departments (the U.S. Census Bureau, U.S. Department of Health and Human Services, Health Resources and Services Administration, Centers for Disease Control and Prevention (CDC), Department of Agriculture, Texas Department of State Health Services, Economics of Food Farming, Natural Resources, Rural America, etc.), nonprofit organizations (March of Dimes, NeedyMeds, The Cooper Institute, etc.), and independent entities (Trust for America's Health, Texas Medical Association, etc.). Analysis of the information collected took the form of descriptive statistics and geospatial visualizations produced through statistical and mapping software. This study utilizes several state and national data sets to ensure a robust picture that includes all of Harris County with verifiable, validated comparability to other counties and regions.

3. **A literature review of various topics and their impact on health.** This includes academic papers and locally published reports like area hospital community health needs assessments and surveys (UTHealth School of Public Health (UTSPH) 2018 Health of Houston Survey, Episcopal Health Foundation (EHF) Capacity Report, etc.) and others which provided background information and data for the study.

4. **Environmental scan of best practices and model frameworks.** External health reports, strategic plans, and progress reports to oversight committees and other political structures from CDC and other public health departments, both large and small, across the United States were reviewed (Cook County, Illinois; Los Angeles County, California; Maricopa and Pima Counties, Arizona; Davidson County, North Carolina, New York City, and others in Texas, etc.). A comprehensive matrix with over 50 examples of programs from across the country was created. To gain additional insight into model frameworks, the staff of HCPH also conducted informal interviews with key staff from other public health departments across the country to discuss lessons learned and other information that may not be published in written form.

5. **Economic and cost analyses to determine ROI for public health strategies.** ROI was compared to other public health programs to provide a comparable frame of reference. ROI analyses of external public health programs and interventions were examined by exploring the published literature.

6. **Geospatial Information System (GIS) mapping.** Data is shown in various geographies depending on availability and scope of the analysis required for each portion of the report. Due to the tremendous data granularity in Public Use Microdata Area (PUMA) geographies available from HCPH partners such as UTSPH, it is greatly beneficial to visualize and interpret sub-county data in the smallest, most local geography available (Figure 1.2). Surveys and analysis in PUMAs tend to be a higher-level overview of a community versus smaller geographies like census tracts or zip codes but allow better insight into the true health of a community that would otherwise only be statistically reliable at the county level.

7. **Feedback from community members and consultation with experts, Harris County departmental staff, and county partners and stakeholders.** HCPH utilized mixed methods to receive feedback and guidance to drive the contents of the report. In 2019, HCPH interviewed and surveyed numerous community residents within each precinct to obtain their own views of health and experiences navigating health systems within Harris County. These surveys built on the analysis from a countywide survey of 2,450 residents conducted by HCPH in the fall of 2017. In addition, HCPH invited one hundred stakeholders in leadership roles of academia, health systems, philanthropy and economic development, social services and community development, and state/national associations to participate in a survey. This survey was on the strengths and challenges of addressing the health issues of Harris County and what the priorities of a local public health department should be.

For a deeper dive, local government partners were asked to participate in guided interviews consisting of three to six questions on key issues and factors affecting county governance and the health of Harris County residents. Follow-up meetings were then conducted to ensure there were no significant discrepancies in perspectives as the findings were further refined. Qualitative methodology was then applied to analyze the responses and determine the top responses overall and by sector and organization type.

Figure 1.1 Commissioner Precincts

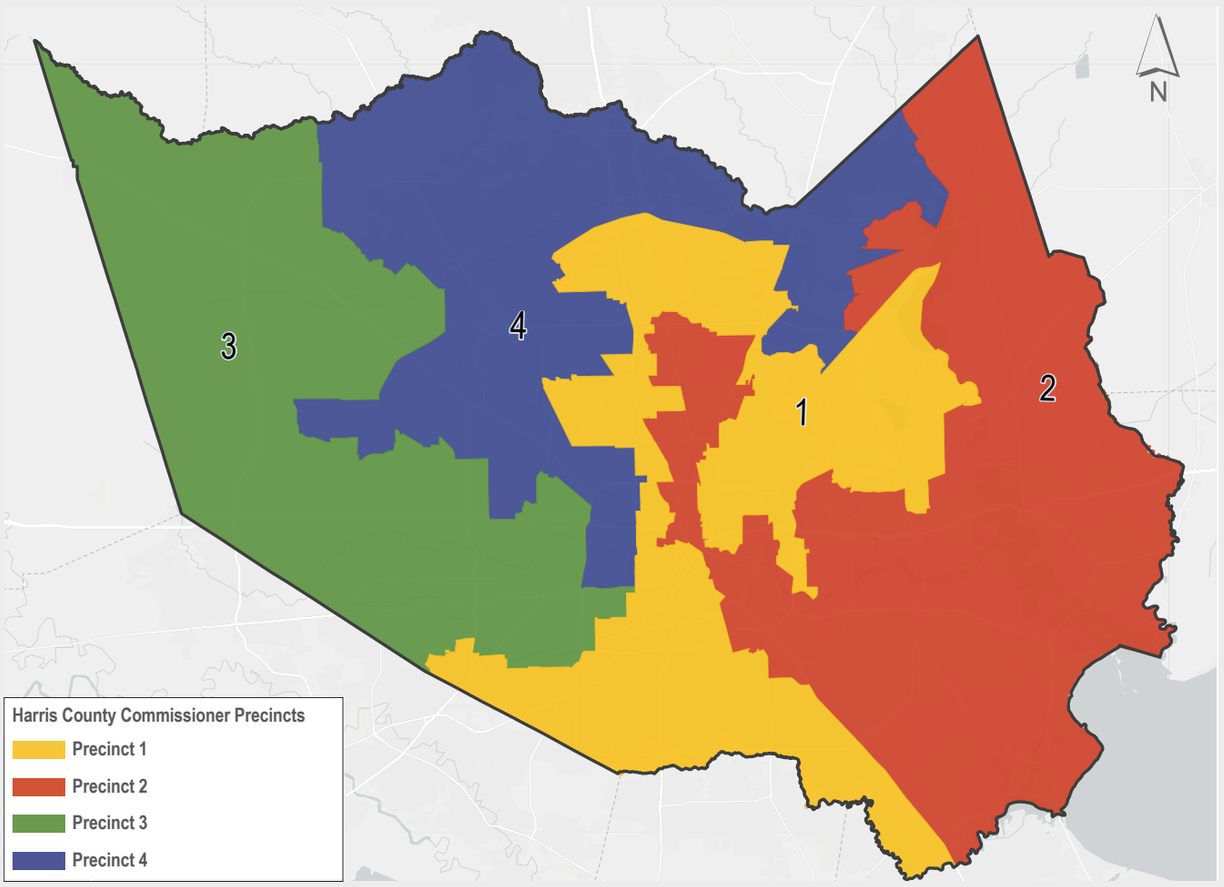


Figure 1.1 Commissioner Precincts, Harris County, TX.
Source: Harris County Public Infrastructure.

Demographics

Harris County is located in the southeastern part of Texas. It's the most populous county within the state and the third most populous within the United States. Harris County is separated into several neighborhoods (or PUMAs as defined in Figure 1.2) and municipalities (Figure 1.3) and has densely populated areas and rural areas as shown in Figure 1.4. If Harris County were a state, it would rank as the 25th most populous, between Alabama (4.9M) and Louisiana (4.65M). With approximately 1,778 square miles, it includes the majority of the Houston–Woodlands–Sugar Land metropolitan statistical area, which has an annual Gross Domestic Product (GDP) of nearly $500 billion.[7]

Harris County's population continues to grow, adding nearly 90,000 residents each year since 2010.[8] Much of this growth is occurring in the unincorporated areas of Harris County at a rate three times that of the City of Houston. More than two million of Harris County's 4.7 million residents live in "unincorporated" areas. This situation is unique among large urban counties in Texas (and even across the United States). In contrast, Dallas County, for example, has 68 square miles of unincorporated territory, which is only 7.5% of Harris County's total square area. Dallas County's unincorporated area comprises approximately 10,000 people (compared to two million such people in Harris County).[9] The unincorporated area of Harris County is expected to pass the total population of the City of Houston in early 2020 (Figure 1.5). This large growth rate will place additional burdens on health care infrastructure for the county.

Figure 1.2 Public Use Microdata Areas

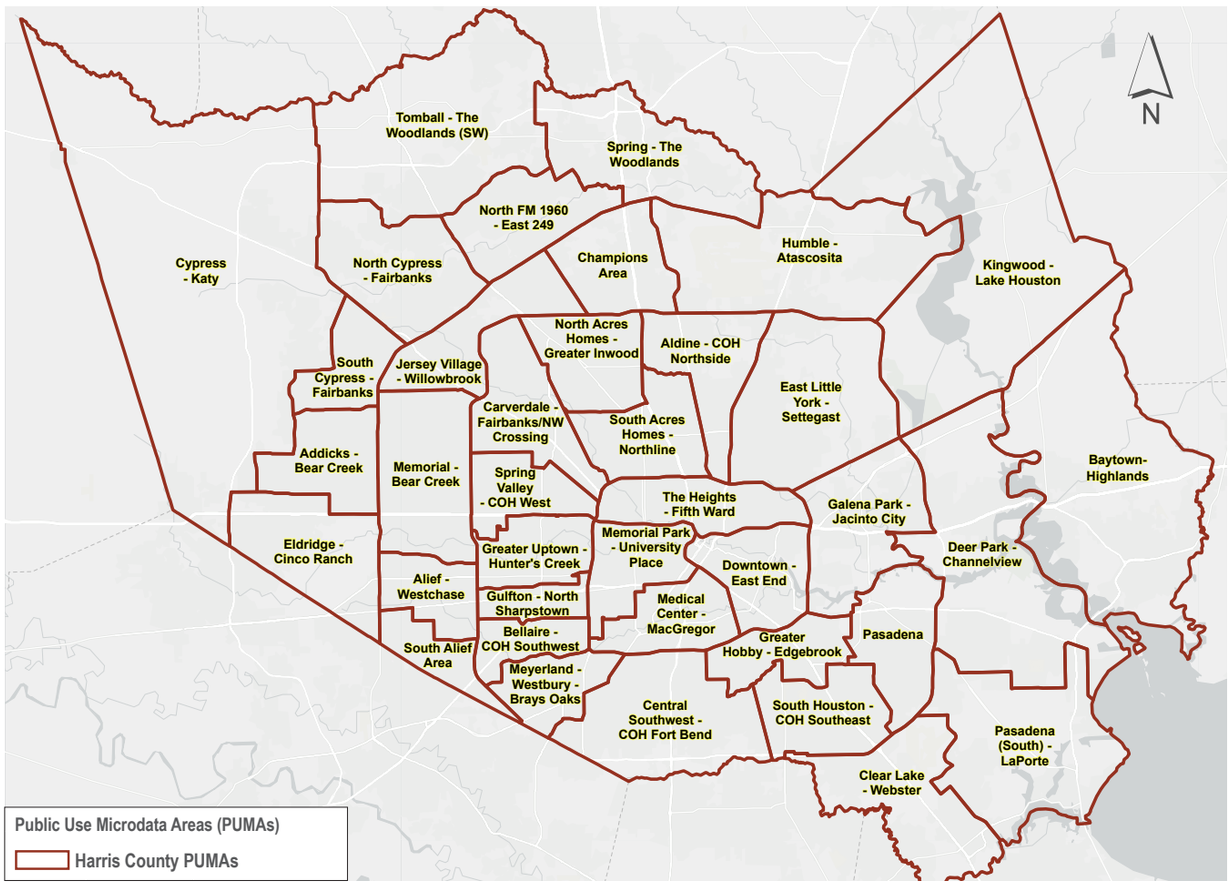


Figure 1.2 Public Use Microdata Areas (PUMAs), Harris County, TX.
Source: US Census Bureau, 2010.

Figure 1.3 Municipalities

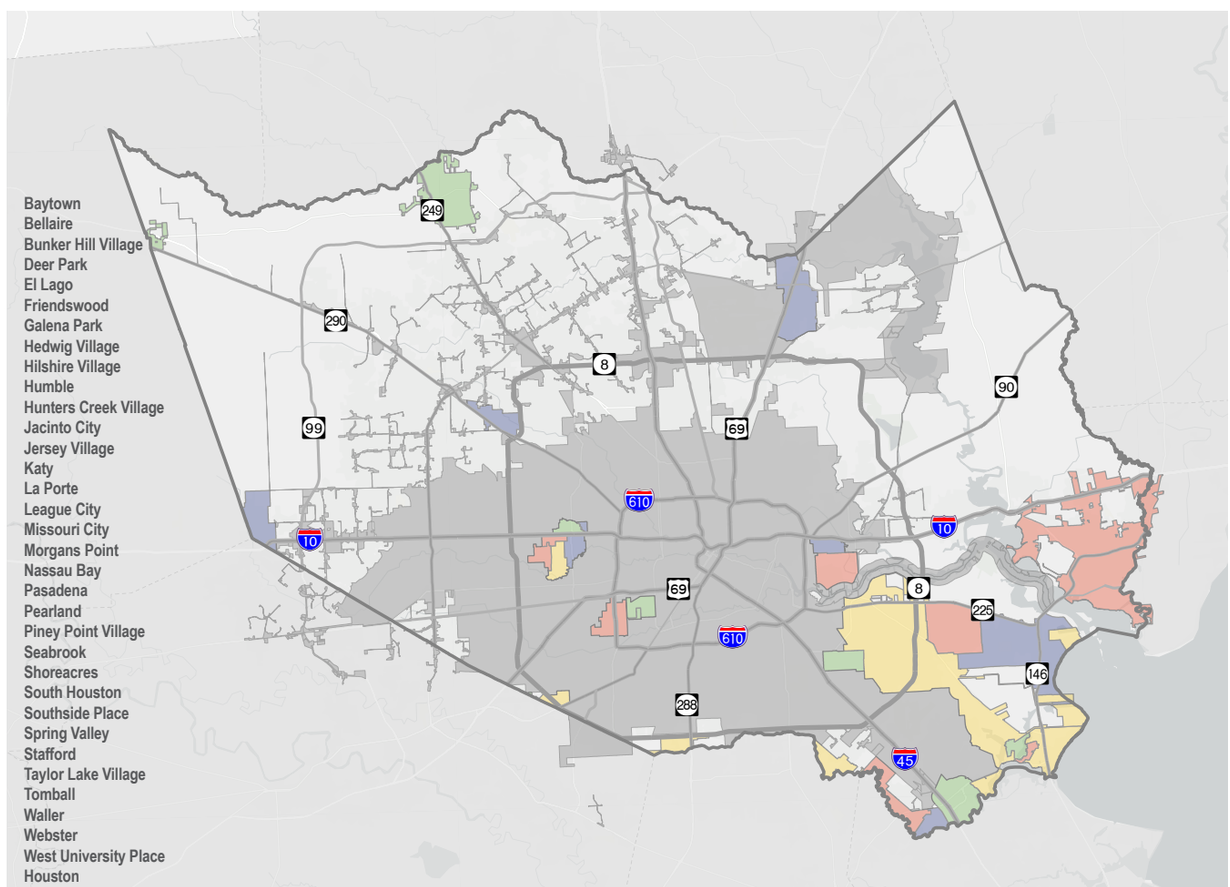


Figure 1.3 Municipalities, Harris County, TX.
Source: Harris County Public Health.

As described by Rice University's Kinder Institute for Urban Research, the "governance of the Houston region is split among hundreds of government jurisdictions.... This fragmented regional governance system is responsible for directing the provision of essential services to residents across jurisdictions and therefore influences the region's growth and development practices."[10] These differences also influence the region's health in Harris County; they contribute to a system with blurred accountability. Whom should an uninsured, asthmatic Houstonian who lives downtown and makes too much to be covered by Medicaid hold responsible for the external factors that contributed to their poor health: the hospital system (County), the public health agency (County or City), those responsible for declining Medicaid expansion (State or Federal), or those responsible for building the "Pierce Elevated" (an area of I-45 by Pierce street that is south of I-10) (City, County, or State)?

These complexities all but ensure that inefficiencies in the system will add additional costs to the delivery of care. To help in offsetting these costs, public health and medical care delivery across multiple agencies overseen by multiple jurisdictions need to be better coordinated, streamlined, and innovative.[11]

Versatile avenues to provide basic health services to the community are needed to serve such a sprawling and growing population with the intention of looking towards the future. To ensure clinical and public health services are available to all Harris County residents, Harris County should consider innovative and sustainable approaches to the root drivers of health.

Additionally, Harris County continues to grow in its diversity as a major hub for immigrants and refugees partially due to its industries, academic institutions, medical center, major airports, and the Port of Houston. The Greater Houston Area is considered one of the most ethnically diverse metropolitan areas in the United States, with more than 145 different languages spoken.[12] As seen in Figure 1.6, Harris County has been a majority-minority population since 2000 and mirrors what the rest of the United States will look like in about four decades. In 2013-2017, Harris County was comprised of 42% Hispanic, 31% White, 19% Black, and 8% Asian/Other.[13] In fact, Asians are the fastest-growing racial/ethnic group in Harris County in recent years.[14]

A quarter of Harris County's population is foreign-born, making it the fifth largest foreign-born population in the United States after New York City, Los Angeles, Miami, and Chicago.[15] Between 2010 to 2017, the area's foreign-born population grew at the highest rate (23%) compared to 17% in Miami, 9% in New York City, and no significant growth in Los Angeles or Chicago.[16] In 2017, three-quarters of the immigrants (1.2 million) in the 12-county Houston metro region lived in Harris County. Undocumented immigrants make up less than one-third of immigrants in the Houston area.[17] Most undocumented immigrants are from Mexico and Central America, however there is also a significant proportion of immigrants from several Asian countries. While this diversity is fully embraced at every level of government, it does present unique challenges in communication, cultural competence, and in ensuring all communities and populations have a voice at the table.

Figure 1.4 Population Density

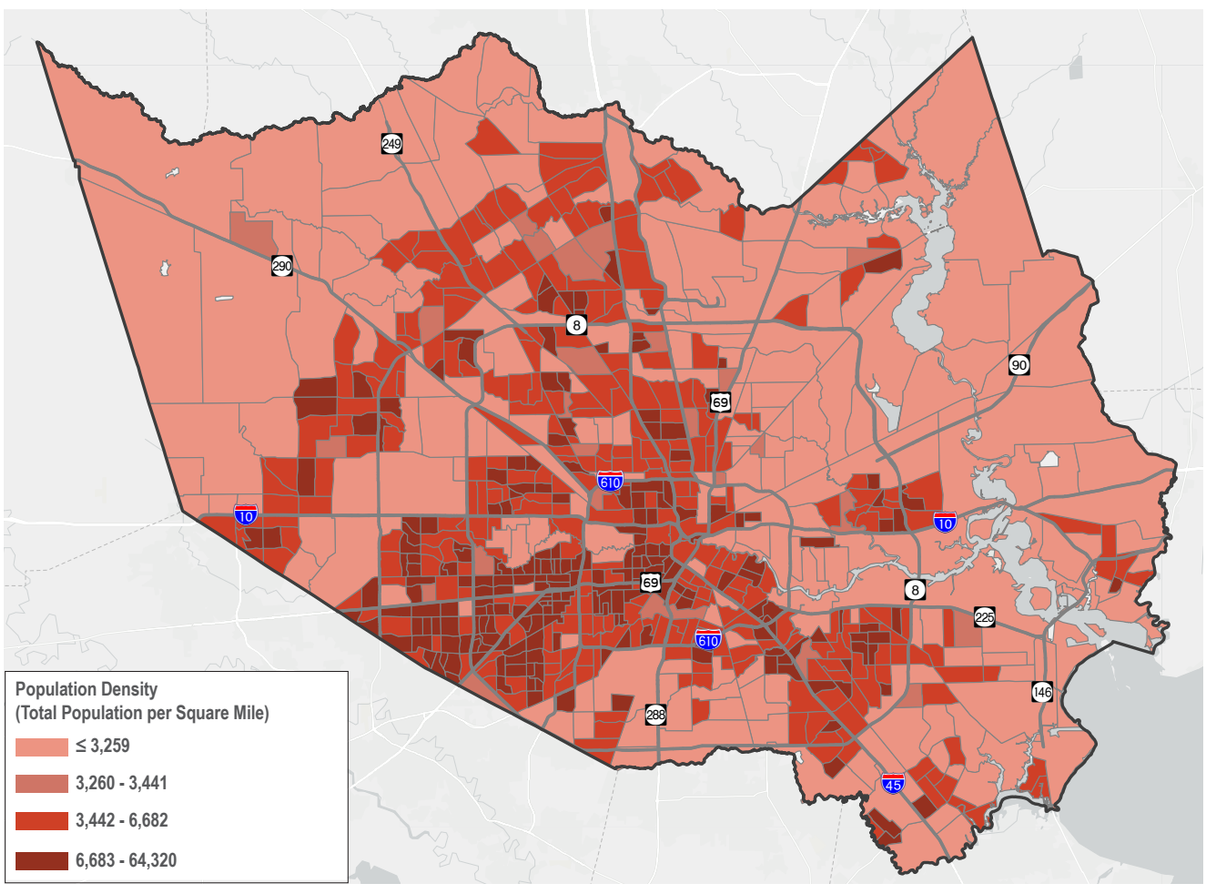


Figure 1.4 Population Density by Census Tract, Harris County, TX, 2018.
Source: Esri Demographics, 2018 (Estimated based on Census 2010 geographies).

Social vulnerability is a particular way of describing the characteristics of a community and refers to the resilience of communities when confronted by external stresses on human health. This includes those from natural or human-caused disasters, or disease outbreaks. CDC offers a social vulnerability index (SVI) which maps social factors that affect resiliency by census tract into four themes: socioeconomic status, household composition, race/ethnicity/language, and housing/transportation. Harris County's social vulnerability index can be seen in Figure 1.7. Harris County has already utilized this mapping asset as a planning component for flood mitigation projects. This index and others offer an opportunity for departments to align efforts for maximum social impact with targeted, place-based interventions.

Figure 1.5 Population Projections

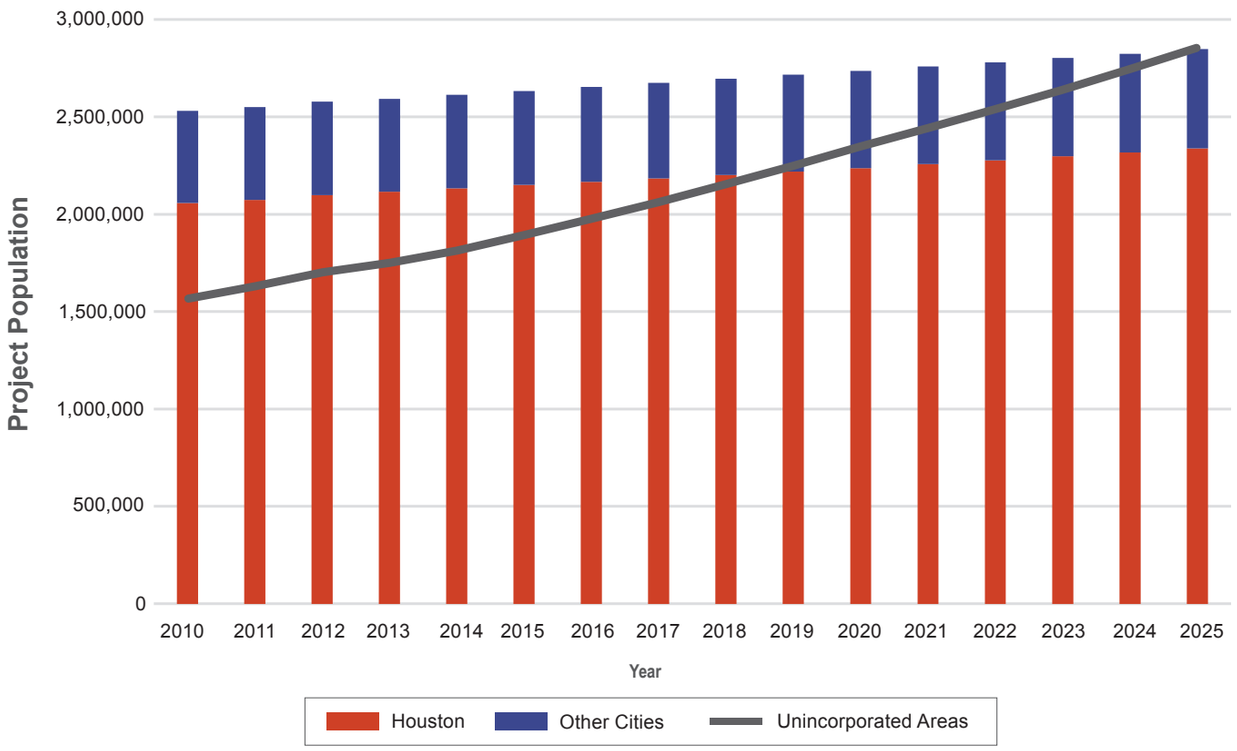


Figure 1.5 Population Projections, Harris County, TX, 2010-2025.
Source: Adapted from Harris County Budget Management (Bruce, 2019).

Figure 1.6 Demographic Changes

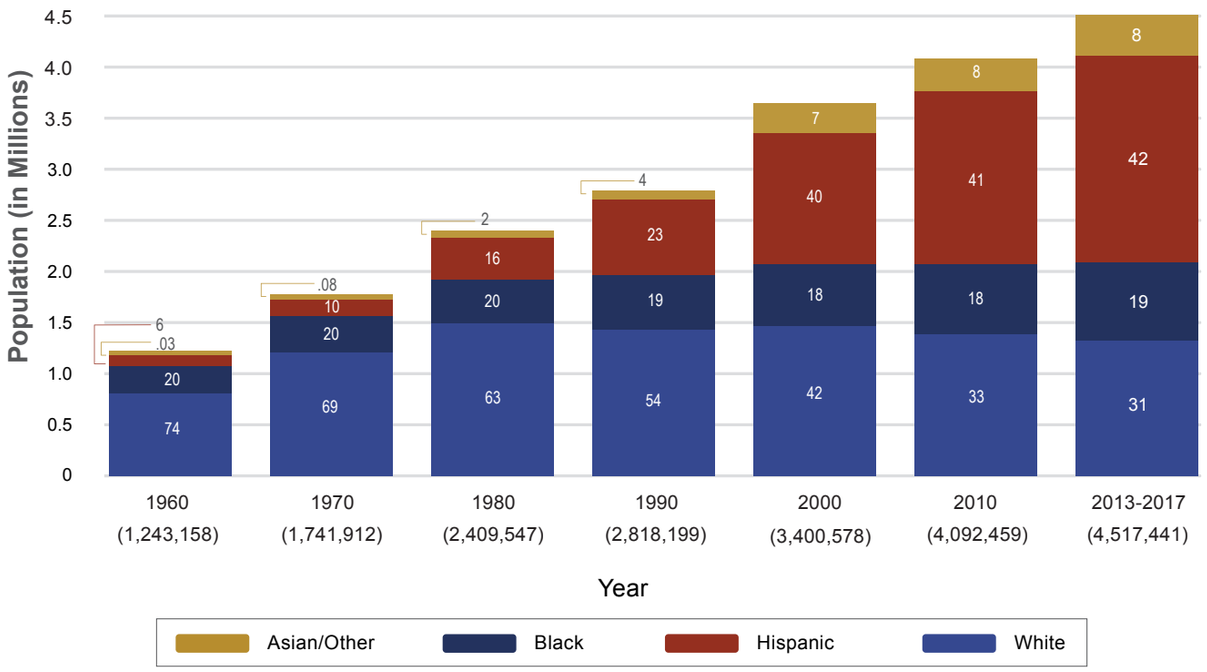


Figure 1.6 Demographic Changes in Harris County by Decade (1980-2010) and ACS Estimates (2017).
Source: Adapted from Rice Kinder Institute for Urban Research; American Community Survey, US Census Bureau, 2013-2017.

Table 1.1 Life Expectancy of Comparable Countries

Country	2013	2014	2015	2016	2017
Australia	82.2	82.4	82.5	82.5	82.6
Austria	81.2	81.6	81.3	81.7	81.7
Belgium	80.7	81.4	81.1	81.5	81.6
Canada	81.7	81.8	81.9	82.0	82.0
France	82.3	82.8	82.4	82.6	82.6
Germany	80.6	81.2	80.7	81.1	81.1
Japan	83.4	83.7	83.9	84.1	84.2
Netherlands	81.4	81.8	81.6	81.6	81.8
Sweden	82.0	82.3	82.3	82.4	82.5
Switzerland	82.9	83.3	83.0	83.7	83.6
Turkey	78.0	78.0	78.0	78.0	78.1
United Kingdom	81.1	81.4	81.0	81.2	81.3
United States	78.8	78.9	78.7	78.7	78.6

Table 1.1 Life Expectancy for Comparable Industrialized Countries, 2013-2017.
Note: Comparable industrialized countries as determined by the Kaiser Family Foundation.
Source: Organization for Economic Co-operation and Development Health Statistics.

Life Expectancy in Harris County

> Zip code is a better predictor of health than one's genetic code. The gravity of this fact is unmistakably felt when one realizes that neighbors who live 20 minutes apart could expect to live 20 years less.

Research shows that dense, immigrant-friendly, and well-educated communities have higher life expectancies.[18] While the life expectancy in the United States lags behind many other comparable industrialized nations in the world, there are differences among and within states (Table 1.1, Figure 1.8). In Texas, the average life expectancy is 78.5 years, but can vary by as much as 30 years between zip codes within the state.[19]

Life expectancy is the average number of years that a newborn can expect to live, assuming mortality patterns at the time of birth remain constant and is calculated using available death records.[20] The life expectancy of a population is one of the key measures of population health. As seen in Figures 1.8 and 1.9, life expectancy is highly variable in both the United States and Texas.

In Harris County, the average life expectancy is 78.7 years, and the range of life expectancy is 23.4 years. In other words, some residents can expect to live 89.1 years while others just 65.7 years (Table 1.2).[21] However, this varies by sex, race/ethnicity, and zip code. In fact, zip code is a better predictor of health than one's genetic code. Life expectancy ranges from just 72 years, on average, in the East Little York-Settegast area to 82 years in the Memorial-Bear Creek area - a difference of 10 years (Figure 1.10).[22] According to UTHealth, Blacks in Harris County have a lower life expectancy at 75.3 years, compared to Whites (78.2 years) and Hispanics (83.9 years), with Black males having the lowest life expectancy (72.3 years).[23]

Table 1.2 Life Expectancy

Geography	Life Expectancy
Harris County	78.7
Texas	78.5
United States	78.6

Table 1.2 Life Expectancy for Harris County, Texas, and the United States, 2010-2015.
Source: Robert Wood Johnson Foundation.

Conclusion

With a growing population in Harris County, the importance of planning the development and expansion of communities with health in mind will have a significant impact on the life expectancy of the population. It should also be noted that life expectancy overall in Harris County and differences within Harris County by population and/or geography should be a key metric to follow and track success of health interventions over time.

In addition to a growing population, another severe pressure on the public health and clinical care system is Harris County's disproportionately high uninsured population. Harris County has one of the highest percentages of uninsured individuals in the nation. It is clear that public health and health care need to radically transform to continue serving the needs of the community.



Figure 1.7 Social Vulnerability Index

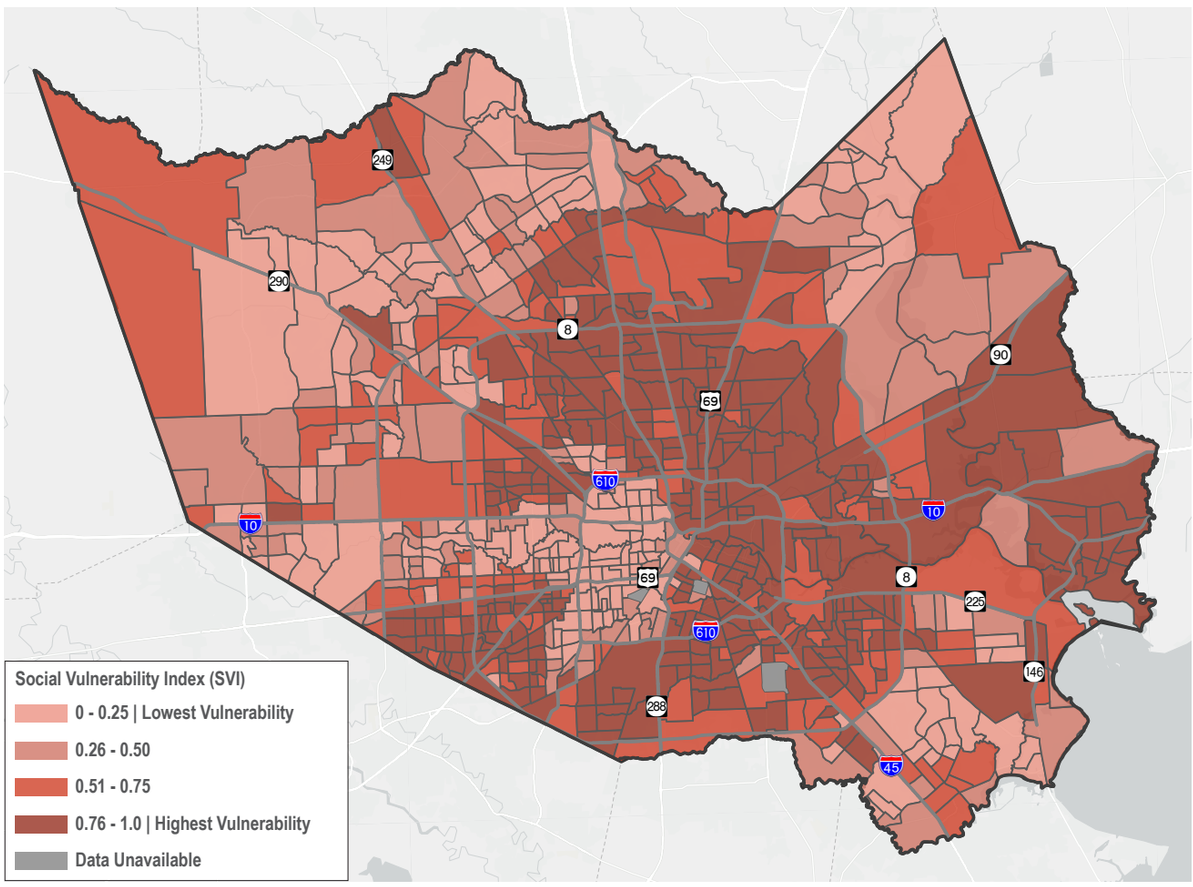


Figure 1.7 Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
Source: Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Figure 1.8 US Life Expectancy

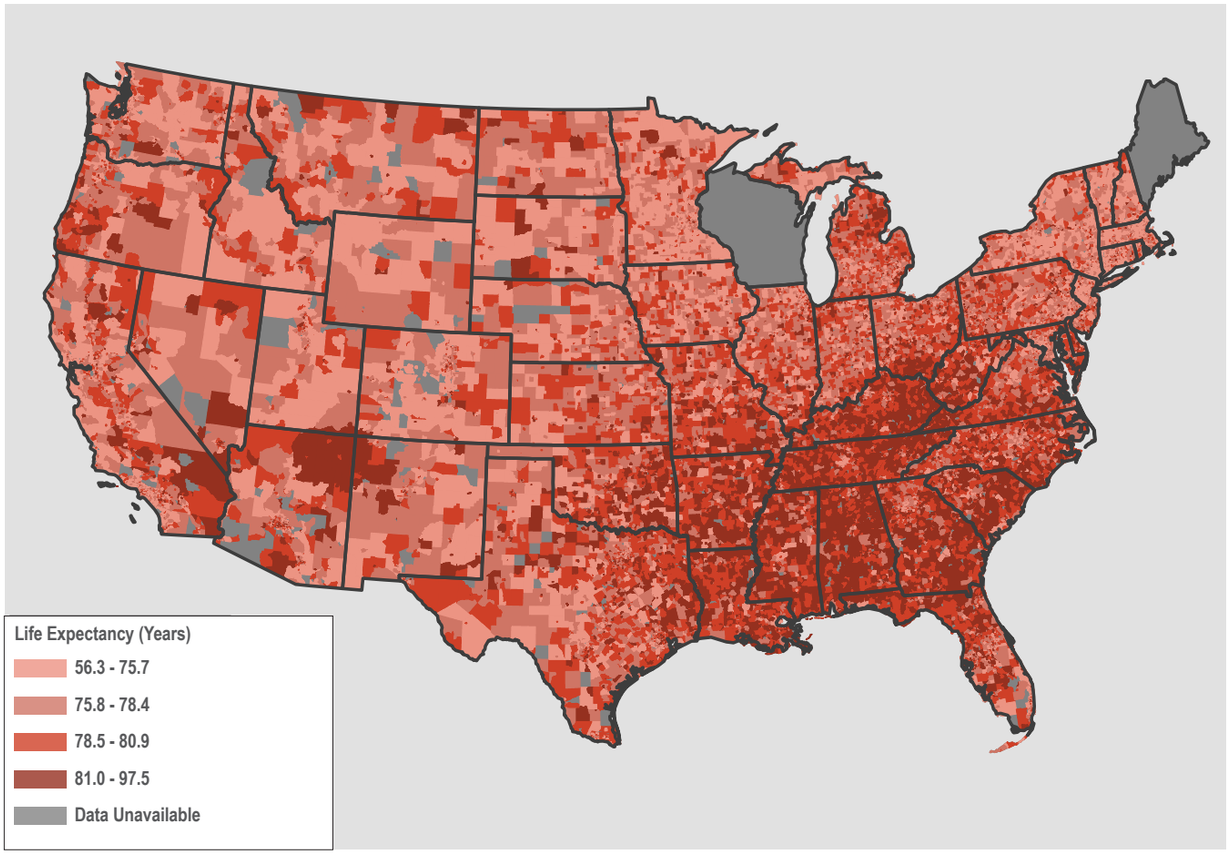


Figure 1.8 Life Expectancy by Census Tract, United States, 2010-2015.
Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2010-2015.

Figure 1.9 Texas Life Expectancy

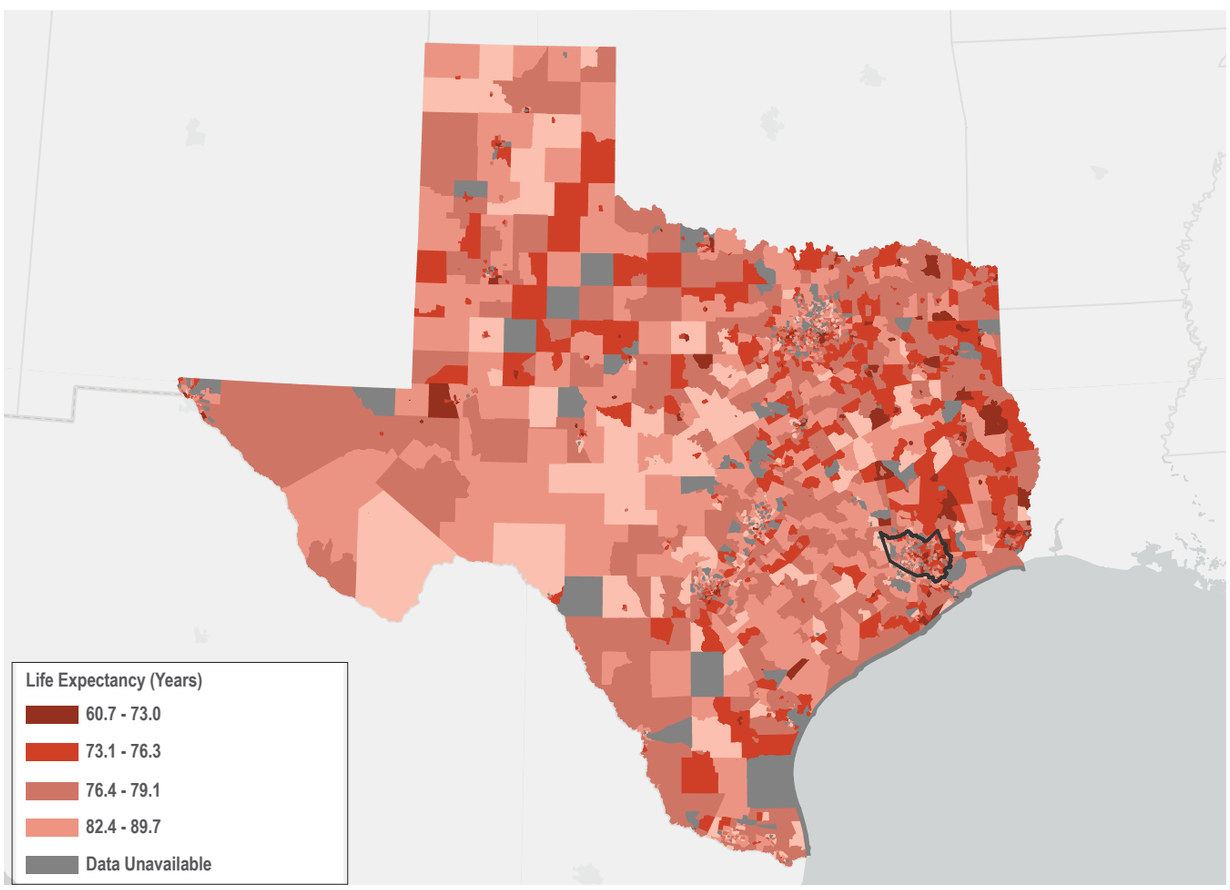
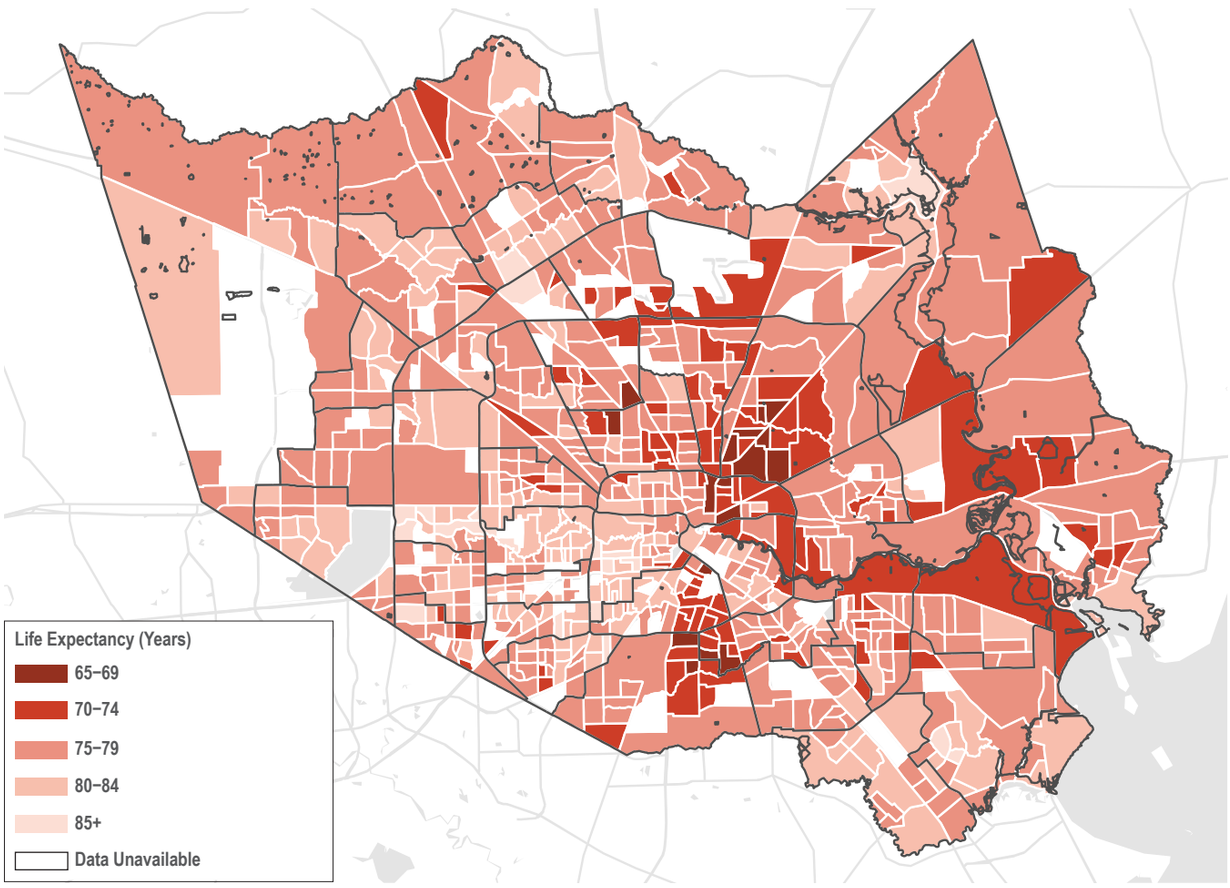


Figure 1.9 Life Expectancy by Census Tract, Texas, 2010-2015.
Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2010-2015.

Figure 1.10 Life Expectancy



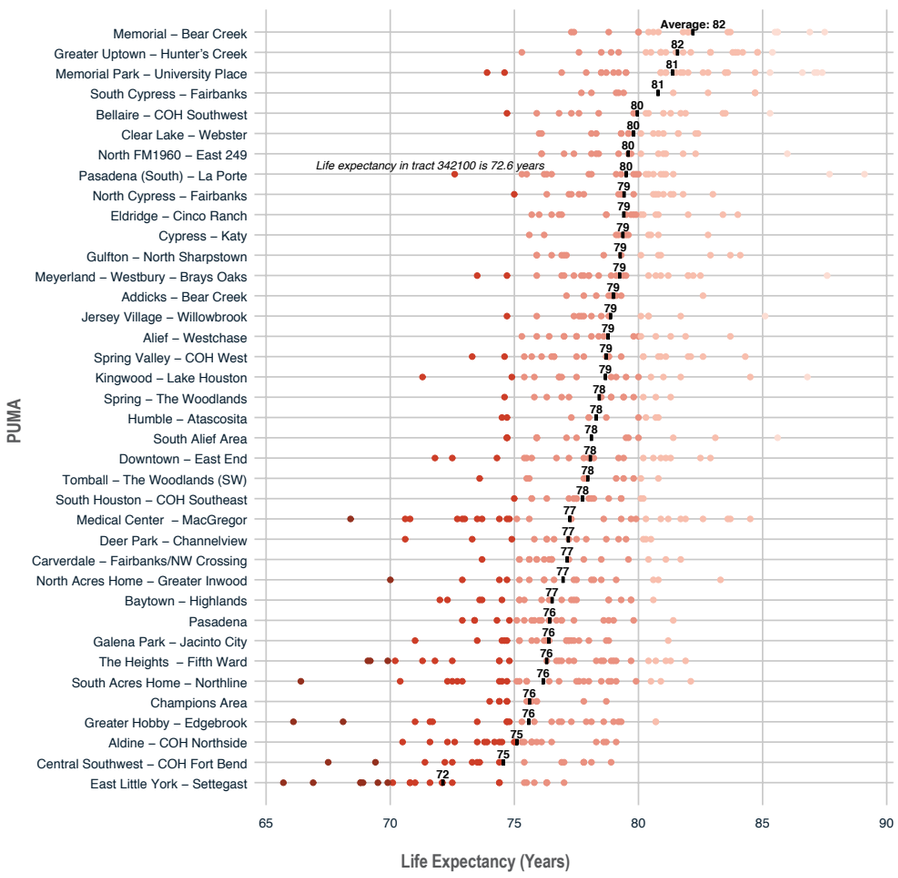


Figure 1.10 Life Expectancy by Census Tract and PUMA, Harris County, TX, 2010-2015.
Note: Each dot represents a census tract within each neighborhood.
Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2010-2015.



"What will the 'H' represent in 10 years? Much more than 'Hospital.' People should see it and think of 'Health.' ... Our focus should be on determinants of health, not just health care or hospital care."

- American Hospital Association

2

Public Health and Health Care

Public health is defined as "fulfilling society's interest in assuring conditions in which people can be healthy" and as a "collective effort to identify and address the unacceptable realities that result in preventable and avoidable health outcomes."[25] Public health defines "population health" as the "health outcomes of a group of individuals, including the distribution of such outcomes within the group."[26]

Public health has been managing population health for over 150 years. Some of the greatest public health achievements have occurred over the last century — vaccinations, safer foods, motor vehicle safety, improved drinking water quality, enriched nutrition, control of infectious disease, improved management and prevention of heart disease, and other important health-related advancements.

A health care delivery system is an organization of people, institutions, and resources to deliver health care services to meet the health needs of a target population.[27] The history of medicine and health care spans centuries. Medical advancement, both through technology and science, as well as coordinated planning and infrastructure, has progressed health care delivery lightyears from care delivered in the poorest of almshouses.[28]

Institutions within the TMC have boasted over 10 million patient encounters per year, and one surgery is performed every three minutes.[29] However, in a step forward beyond medical science, it should be noted that TMC has recognized the importance of being engaged in health policy, as evidenced through the recent creation of the TMC Health Policy Institute.



Introduction & Background

Although the United States pays more for medical care than any other country, problems thrive in its current health care system. A good health care system delivers quality services to all people, when and where they need them.[30] Unsustainable costs, poor outcomes, frequent medical errors, poor patient satisfaction, and worsening health disparities all point to a need for transformative change.[31]

In reality, the US health care system uses "a piecemeal, task-based system that reimburses for 'sick visits' aimed at addressing acute conditions or acute exacerbations of chronic conditions. Economic incentives encourage overuse of services by favoring procedural over cognitive tasks (e.g., surgery vs. behavior change counseling) and specialty over primary care." The health care safety net in Harris County (Figures 1.11, 1.12) is the loosely organized system of public and private health care providers that voluntarily provide medical services at discounted prices to the uninsured, underinsured, and those on Medicaid.[32]

Disease prevention through public health does not necessarily mean that the disease can always be eliminated such as smallpox had (the last known case of smallpox death was in 1978 in Africa), rather prevention efforts run the continuum and aim to limit the disease's clinical progression.[33] Even if some prevention efforts do not add to total lifespan, they can greatly extend the disease-free portion of a lifespan and can constrain certain chronic diseases at the end of life to a shorter time frame.[34]

"How can we help the country understand that health is about more than healthcare? It takes a culture shift."

- Dr. Karen B. DeSalvo,
UT Dell Medical School, Former Assistant Secretary for Health, US Department of Health and Human Services



“It is vital to have local solutions to local problems...we have some innovative thinking here that can create new ways to tackle some of our challenges.”

- Dr. Chad Lemaire, Legacy Community Health, Doctors for Change

Figure 1.11 Types of Health Care Facilities

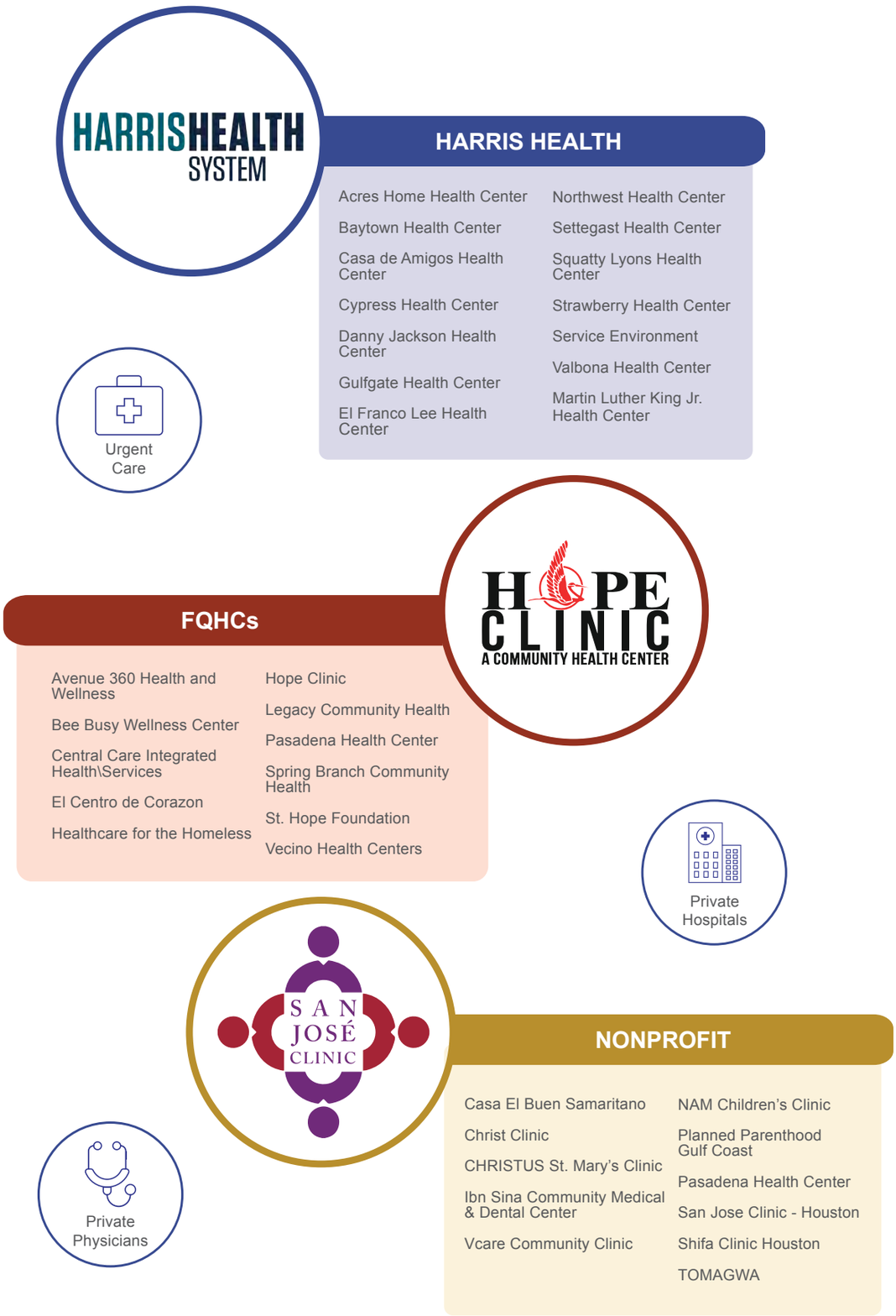


Figure 1.11 Types of Health Care Facilities.
Source: Adapted from Pugil et al. (2019).

Figure 1.12 Services Offered in Safety Net Facilities



Figure 1.12 Services Offered in Safety Net Facilities.
Source: Adapted from Pugil et al. (2019).

Public health is intertwined with, yet distinct from, health care in that it prevents and controls disease and injury with the community as the patient (Figure 1.13). **Advances in public health have increased life expectancy by 25 years compared to just five added years from medical advances in the United States.**[35] High-quality health care must be effectively coupled with a robust public health system to provide optimal health for individuals and populations. However, this distinction is evolving with comprehensive health care reform through the Patient Protection and Affordable Care Act (ACA) that was passed into federal law in 2010.

As a result of the ACA and other market forces, health care systems are making fundamental changes to their role in the health care delivery system as they transition to value-based care from a fee-for-service model.[36] Unlike fee-for-service, where medical care is transactional and overutilization is incentivized, value-based care is a care delivery model where hospital and provider reimbursement are linked to patient outcomes. Once fully realized, this model promises to lower costs and improve health outcomes.[37] This shift includes hospitals pursuing population health management of their patient panels – despite continued uncertainty over the ACA.

In the health care sector, population health refers to the management of a defined patient panel or "population" of patients with a certain health condition or set of health conditions. The Institute for Healthcare Improvement's (IHI) Triple Aim Initiative defines population health as, "the work done by health care organizations to improve outcomes for individual patients to maximize population health."[38] IHI's Triple Aim framework provides a foundation for organizations and communities to make the transition from a focus on health care to the optimization of individual and population health by: (1) improving the health of the population, (2) enhancing the patient experience and health outcomes, and (3) reducing the per capita cost of care.[39]

Like much of the rest of the health care system across the nation, Harris Health, as indicated in its 2020 Strategic Plan,[40] is committed to aggressively innovating a value-based model that works for its agency and the community. Because Harris Health has operating expenses of over $1 billion per year,[41] it's critical that this transformation be done in a financially stable and sensible manner.

Much like medicine, the practice of governmental public health has evolved over time. In the early decades of the 20th century, it was focused on preventing the spread of infectious diseases through the provision of clean water systems, effective waste removal, and improved food safety. Once a multitude of vaccines were developed in the 20th century, public health played a critical role in their widespread utilization, which helped eliminate the specters of measles, smallpox, polio, and other diseases in the United States and many countries around the world.

As a result of these successes in infectious disease prevention and control, in the 21st century, chronic diseases now pose a bigger threat to the population's health and

Figure 1.13 Public Health 3.0 Buckets of Prevention

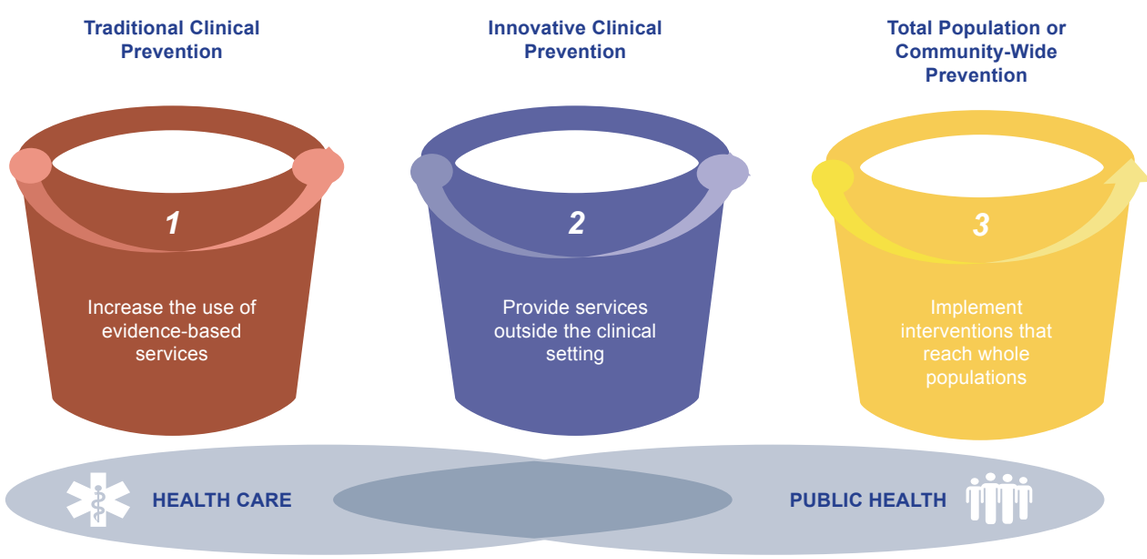


Figure 1.13 Public Health 3.0 Buckets of Prevention.
Source: Adapted from Public Health 3.0 Buckets of Prevention (Auerbach, 2016).

well-being. As infectious disease mortality went down, chronic disease became the primary cause of death. Unfortunately, the solutions to these threats can be far more complicated and require comprehensive, coordinated, and multidisciplinary approaches. A new framework for public health was developed in 2016 by the Office of the Assistant Secretary for Health led by Dr. Karen B. DeSalvo with its seminal report, *Public Health 3.0: A Call to Action to Create a 21st Century Public Health Infrastructure*.[42] This report provided the field of public health with well-defined and actionable steps to respond to modern threats to health. A key recommendation advanced in the report was the idea for local health departments to assume a role as a "community health strategist" by convening structured, cross-sector partnerships to drive initiatives on root causes of poor health.[43]

Across the United States, the impact of the ACA and other movements in health to achieve the Triple Aim will continue to reshape the health care landscape, streamline services, and redefine value. Similarly, reports such as *Public Health 3.0* will reshape the field of public health in America.[44] The fields of health care and public health are recognizing that neither can be truly successful without the other. Given this, **it presents Harris County a strategic opportunity to align and leverage the policies, procedures, and practices of clinical health and public health agencies to improve population health.** The positive impact of such harmonization can be seen in the successful execution of the Medicaid 1115 Waiver project.

> ***"The ultimate goal is to improve health and improving healthcare is only a small piece of that."***
>
> *- Dr. Stephen J. Spann*
> *Founding Dean,*
> *University of Houston*
> *College of Medicine*

Innovation in Public Health and Health Care

1115 Waiver Projects

In 2011, Texas was faced with a growing number of uninsured and uncompensated care costs that were of one of the highest in the nation.[45] Although federal law dictates Medicaid minimum standards related to eligible groups and required benefits, the law gives states flexibility to transform service delivery through waivers. Instead of expanding Medicaid to cover the care of disproportionately impacted populations, which was desperately needed, Texas submitted, and was approved for, a five-year Medicaid 1115 Waiver project. This project allowed the state to experiment with pilot programs that could improve care, increase efficiency, and reduce costs through a state and federal match of funds. The program created two funding pools for Uncompensated Care (UC) and Delivery System Reform Incentive Payment (DSRIP) payments.[46]

Texas organized its 254 counties into 20 regional health partnerships. Implementation of these partnerships was especially innovative because they expanded eligible providers to include not only hospitals but also local health departments, physician practices, and community mental health centers. In Harris County, this allowed for sustainable collaboration between HCPH, other health systems, and the regional health partnership's anchor institution, Harris Health.[47] The direct participation of local public health agencies accounted for 15% of the total DSRIP pool, or about $1.7 billion.[48] Unfortunately, public health is often a mixture of funding sources and financing arrangements that varies widely and is relatively unstable, but DSRIP allowed for an unprecedented investment in public health infrastructure in Harris County and throughout Texas. At HCPH, DSRIP funding allowed HCPH to develop its Public Health Innovations Lab (PHI Lab). It performs similar to a technology "accelerator" program, and allows public health projects to grow rapidly, iteratively, and sustainably.

Case Example:
HCPH offers the Super Smile Savers Program through DSRIP funding. It seeks to improve the oral health of children through collaboration with targeted schools, school districts, Head Start Centers, and communities within Harris County. This program offers preventive dental screenings and fluoride varnish applications, oral health education, and navigator-assisted referrals to community dental providers and has provided preventive dental services to over 21,000 children and navigation-assisted referrals to at least 12,000 of them. Of the children seen, 98% were deemed low-income, uninsured individuals, or Medicaid eligible.

Despite its success to date however, DSRIP was never intended to be a permanent funding stream and public health as a field continues to face severe losses in funding and infrastructure overall. This includes loss of funding from the planned discontinuation of DSRIP funds when it's projected to end over the next few years. In 2017, the Medicaid 1115 Waiver was renewed for an additional five years but with significant redesign that, starting in 2020, tapers down federal DSRIP funding to $0 by 2022. This is especially concerning given that DSRIP funded projects have demonstrated clear health outcomes that have translated into value for the community.[49] For HCPH this means that DSRIP funding would decline by $212,000 in FY 2021, $469,000 in FY 2022, and $2.8 million in FY 2023.

This impending loss is compounded by unclear state and federal policies that threaten mechanisms for federal match of state dollars. Texas has never utilized its own general revenue for 1115 Waiver matching funds in the state budget for Article II and instead relies on intergovernmental transfers and local provider participation funds that are collected through local hospital district and property taxation.[50] At the federal level, this method of financing has been disallowed in some regions and threatens the rest of the state on how funds are distributed between UC and DSRIP projects.[51]

Further, new federal guidance has removed goals of increasing coverage for disproportionately affected populations that need public health and preventive services the most. At the state level, the 86th Texas Legislature (2019) continued to forego Medicaid expansion and did not act meaningfully to explore alternative mechanisms to substitute or supplement local funding that's in jeopardy. Of particular importance is that the local health departments sought to be their own designated Medicaid provider type in the midst of the 1115 emergency through SB 2021 in the 86th legislative session. A designated provider type would have allowed for billing of preventive services that other providers are routinely reimbursed for. While the bill had broad support across Texas LHDs and other key stakeholders, it unfortunately did not pass.

In the face of such uncertainty, there can be no expectations that the state or federal governments will resolve these problems. **The enhancements made to the system through the 1115 Waiver are scheduled to fail.** With 1115 funds expiring, the gaps to access to care for under and uninsured populations will worsen. Harris County must enhance its alignment of both public health and indigent health care delivery systems in ways that are capable of handling innovative streams of funding and resilient enough to withstand potentially devastating losses of state and federal funding. By aligning systems now, Harris County can respond to inaction for Medicaid expansion through options like a unique and locally-resilient health financing mechanism that this study terms, *Harris Care*, to ensure access to low cost or no cost primary and preventive services. However, before such systems-level changes can be proposed, it's important to understand the current, local barriers to access to care in Harris County.

Technology

There are many ways in which technology is used to provide and advance health and health care. From advanced imaging to robotically-assisted surgery to the use of artificial intelligence (AI), health care in the United States is the most technologically advanced in the world. However, these examples primarily address the provision of medical care to individual patients but only indirectly impact the general health of a community at the population level.

Technology gaps exist in a health care system focused more on provision of care after the onset of illness, rather than preventing patients from getting sick or spreading illness. Strategically infusing technology into the public health and health care systems catalyzes innovation in both preventive and care delivery. Applying technology in the public health arena reduces the chances of patients developing illnesses requiring downstream health care services, lowers the risk of sickness spreading through a community, and saves on the cost to the entire system.

An overarching approach that HCPH has applied to developing and deploying technological innovation is through the mantra of "High Tech/High Touch." This can be summarized as embracing technology that preserves one's connectedness and rejecting technology that intrudes upon it. The following are concrete examples of how this concept can help close real-world technology gaps in health care and public health alike.

Standard of care is that patients with tuberculosis (TB) be treated using Directly Observed Therapy (DOT) to both cure the patient who is sick and prevent the spread of this highly contagious illness to others. DOT requires a health worker be physically present to observe and document that the TB patient has taken each dose of medication in a course of treatment that can run from 6-18 months. The disruption of patients' lives and cost to public health departments (particularly in counties as geographically spread out as Harris County) are not insignificant.

HCPH partnered with a startup company affiliated with Johns Hopkins University to be a public health leader in the United States to operationalize a robust telemedicine technology known as Video Directly Observed Therapy (VDOT). This innovation allows TB patients to record their medication doses at a time and place convenient for them, then lets public health workers review and verify those doses via a secure, web-based portal from the office. The technology has demonstrated significant cost savings, sustained medication compliance, and improved quality of patient experiences through its implementation.

As opposed to the above example, sometimes technology does not have to be new but rather can be existing technologies applied in innovative ways. For example, the technology in mobile health clinics and other specialty vehicles is not new. However, HCPH is addressing transportation challenges in a community spread over 1,778 square miles by creating *Health Hubs* as part of its mobile health programming, with the intention of "bringing public health to the public."

A *Health Hub* is a simple building with limited facilities that functions as a place for clients to check-in and wait for health and other services. Services are provided by mobile units that pull up to parking bays on the sides of the *Hub*. The concept is similar to the gate at an airport. People check-in at a simple waiting area before boarding a vehicle outside for services. By rotating the types of mobile health vehicles "plugged into" the *Hub* on any given day, the same simple structure can function as a medical clinic, a dental clinic, or a veterinary clinic (or even additional types of non-health services).

These innovative *Health Hubs* leverage HCPH's nationally-recognized investment in designing and utilizing mobile health units. The *Hubs* not only let HCPH provide more services to more residents, but also allow significant cost avoidance over having to build "brick-and-mortar" clinics. This is possible because the cost of clinical infrastructure (both equipment and personnel) is shifted to the mobile units.

This innovative application of an older technology means more residents can be served throughout a community but at a fraction of the cost. The cost of building a brick-and-mortar medical clinic can range from $2.5M-$5M, for example, depending on whether an existing structure is renovated or a new one is built from scratch. This cost would need to be repeated for providing brick-and-mortar dental and veterinary clinics. The cost of building a *Health Hub,* on the other hand, can range from $450K-$750K, depending on the size of the *Hub* desired. A single Hub can then function for multiple types of clinics by simply swapping out the type of mobile units plugged into it.

While these are just two examples of how technology can help move systems upstream in improving a population's health, it is true that gaps still exist in the application of technology for the provision of innovative care of the general population. Infusing technology thoughtfully and strategically into population-health activities saves money, increases services, and improves the health outcomes for all. It also allows agencies simultaneously to fulfill the goal of being "High Tech/High Touch" while reducing costs.

Figure 1.14 County Health Rankings Model

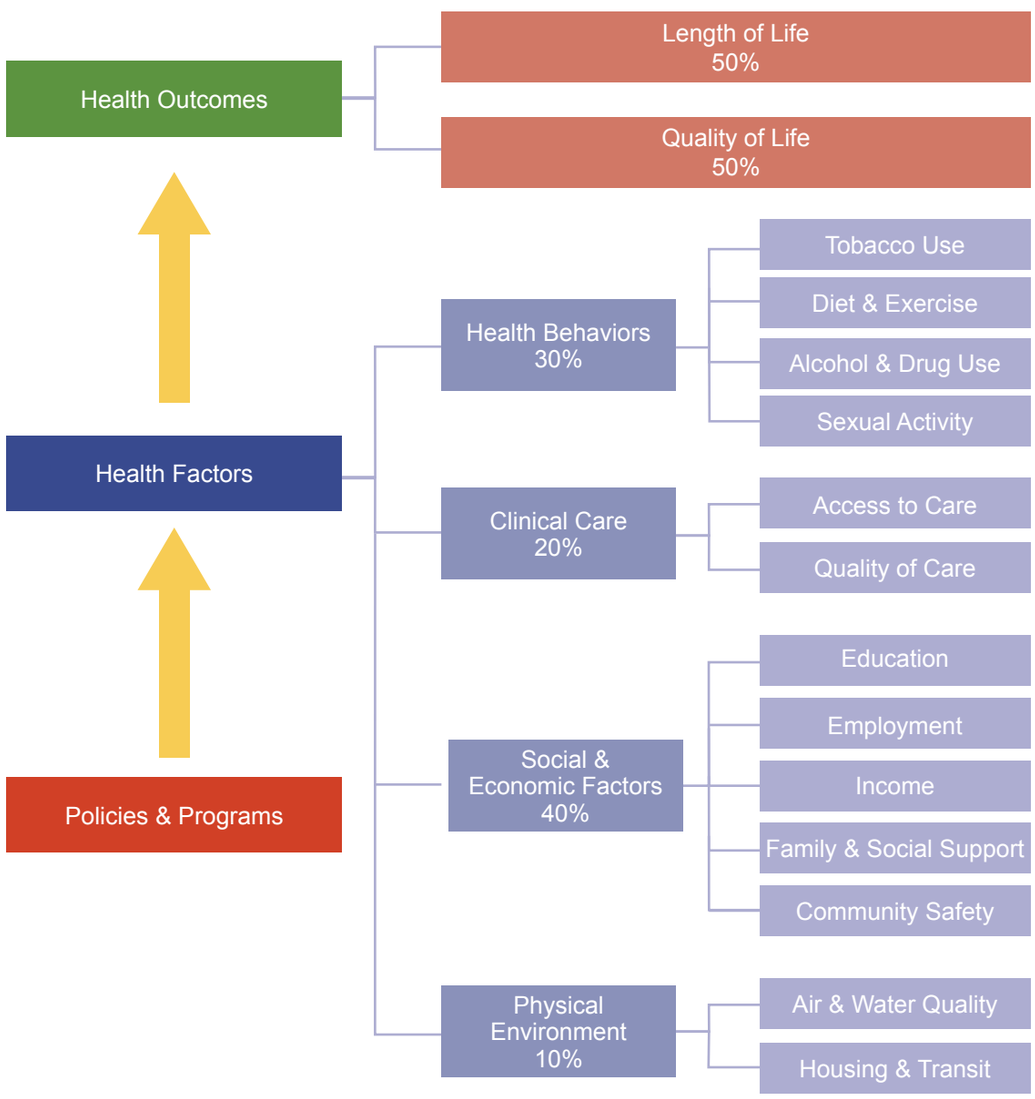


Figure 1.14 County Health Rankings Model.
Source: Adapted from the University of Wisconsin Population Health Institute (2016).

Figure 1.15 A Public Framework, for Reducing Health Inequities

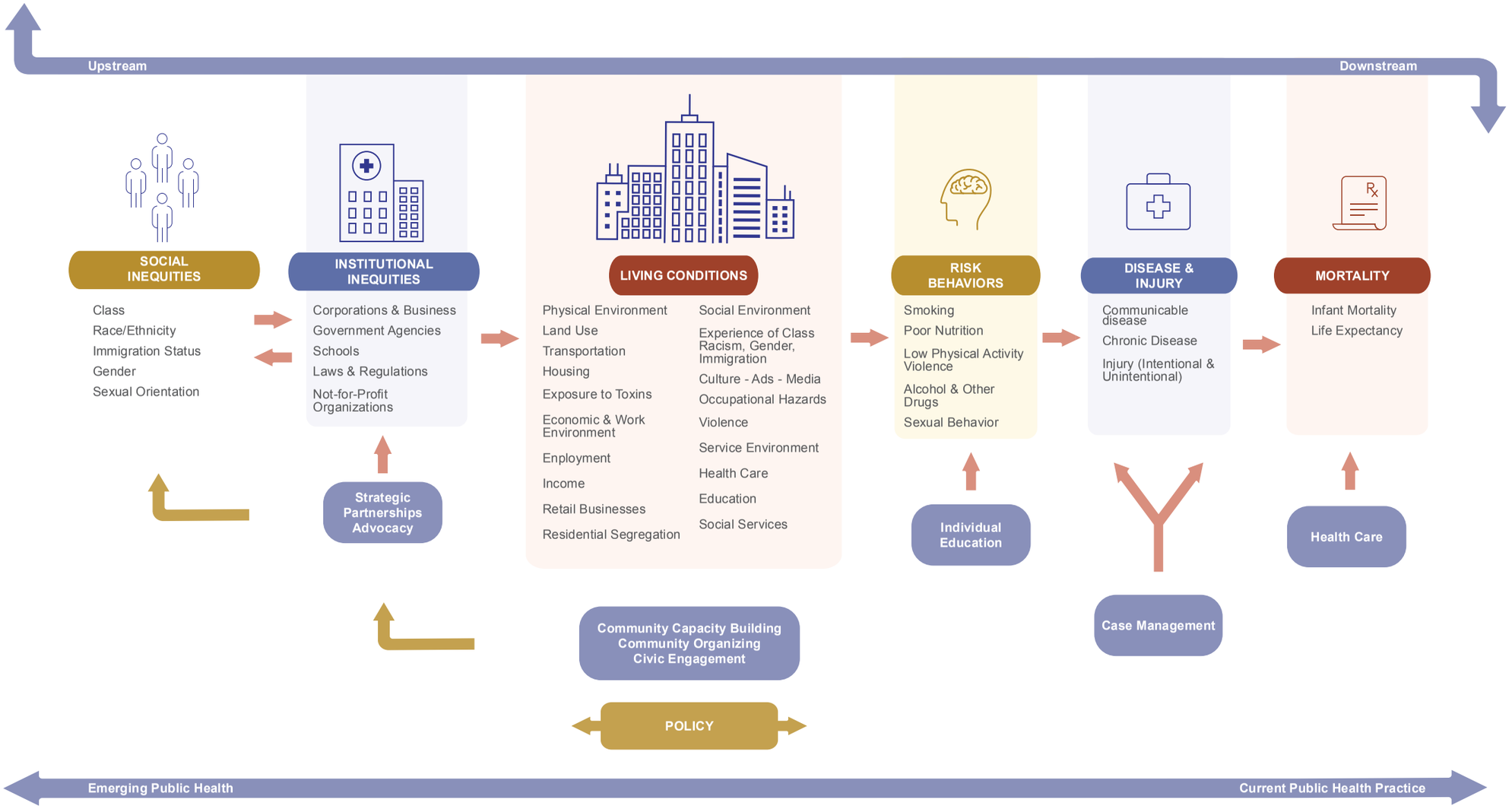


Figure 1.15 A Public Framework, for Reducing Health Inequities.
Source: Adapted from Bay Area Regional Health Inequities Initiative (2015).

Figure 1.16 HCPH Health Equity Framework

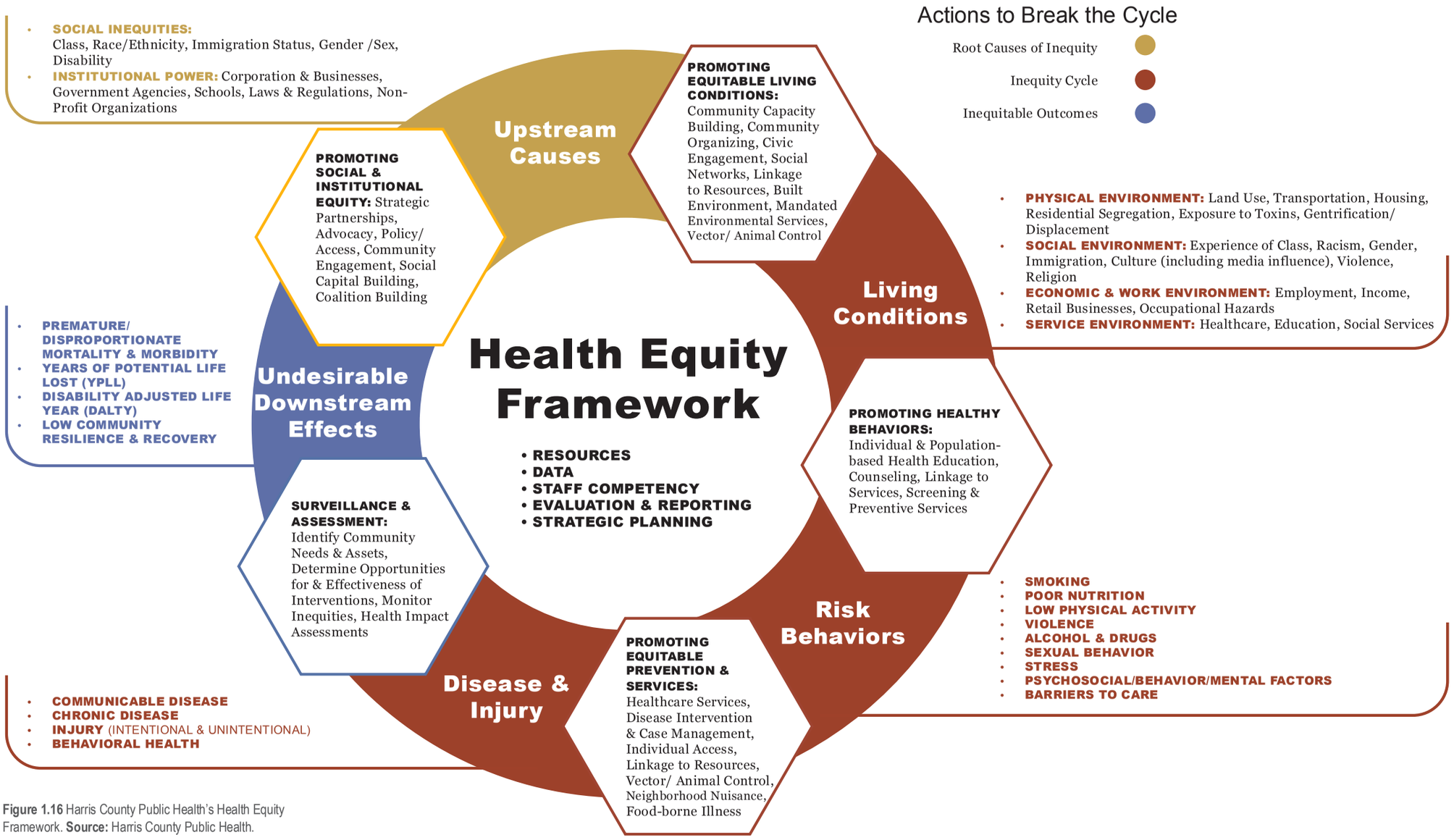


Figure 1.16 Harris County Public Health's Health Equity Framework. **Source:** Harris County Public Health.

System Change

Population health outcomes are the product of multiple inputs of health including policies, clinical care, public health, genetics, behaviors, social factors, and environmental factors, to name a few. In fact, there is a growing awareness and understanding that one's zip code is a better predictor of health than one's genetic code. Clinical care only accounts for 20% of health outcomes (Figure 1.14).[52] Ensuring the health and well-being of Harris County's population requires significant investment in upstream causes of poor health. Currently, the health care system represents approximately 18% of the US GDP and is set to continue to grow. Current investments in health care are considered simply unsustainable. Progressing towards a state of optimal health requires a new framework of what constitutes and what promotes good health.

HCPH has adopted and adapted the California-based Bay Area Regional Health Inequities Initiative's (BARHII) Public Health Framework to understand the root causes of poor health (see Figures 1.15 and 1.16). These frameworks emphasize the need for a systems-level approach to improving population health. Systems changes occur when enough formal, sustainable, and scalable changes to the existing system contribute to measurable improvements in community health. They involve shifts in norms, policies, and processes to support community health.[53]

Figure 1.17 Defining Collective Impact

The Five Conditions of Collective Impact		
	Common Agenda	All participants have a shared vision for change including a common understanding of the problem and a joint approach to solving it through agreed upon actions.
	Shared Measurement	Collecting data and measuring results consistently across all participants ensures efforts remain aligned and participants hold each other accountable.
	Mutually Reinforcing Activities	Participant activities must be differentiated while still being coordinated through a mutually reinforcing plan of action.
	Continuous Communication	Consistent and open communication is needed across the many players to build trust, assure mutual objectives, and create common motivation.
	Backbone Support	Creating and managing collective impact requires a separate organization(s) with staff and a specific set of skills to serve as the backbone for the entire initiative and coordinate participating organizations and agencies.

Figure 1.17 The Five Conditions of Collective Impact.
Source: Adapted from Stanford Social Innovation Review (2012).

Figure 1.18 Phases of Collective Impact

Components for Success		PHASE I Initiative Action	PHASE II Organize for Impact	PHASE III Sustain Action and Impact
	Governance and Infrastructure	Identity champions and form cross-sector group	Create infrastructure (backbone and processes)	Facilitate and refine
	Strategic Planning	Map the landscape and use data to make case	Create common agenda (goals and strategy)	Support implementation (alignment to goals and strategies)
	Community Involvement	Facilitate community outreach	Engage community and build public will	Continue engagement and conduct advocacy
	Evaluation and Improvement	Analyze baseline data to identify key issues and gaps	Establish shared metrics (indicators, measurement, and approach)	Collect, track, and report progress (process to learn and improve)

Figure 1.18 Phases of Collective Impact.
Source: Adapted from Stanford Social Innovation Review (2012).



Public health has traditionally focused on risk behavior modification such as unhealthy eating or tobacco cessation. However, because the root drivers of health are complex and multifaceted, they require systems-level approaches coordinated among partners. Harris County should be working towards building a community where the healthy choice is the easy or default choice.

Examples of these root drivers of poor health exist in large numbers: a resident who can't afford to pay her utility bill is almost certainly unable to afford a high deductible for prescription blood pressure medication. Public health cannot encourage residents to stay fit and physically active if their neighborhood park is unsafe. Asthma medications are costly but are less effective if the child returns home to an apartment that is full of mold and under a congested freeway. A patchwork of individual services and programs for health education and treatment is insufficient to remediate the complicated public health problems of the 21st century. Simply put, a community cannot diagnose, treat, or medicate its way back to good health for problems such as widespread obesity, diabetes, asthma, poor mental health, etc.

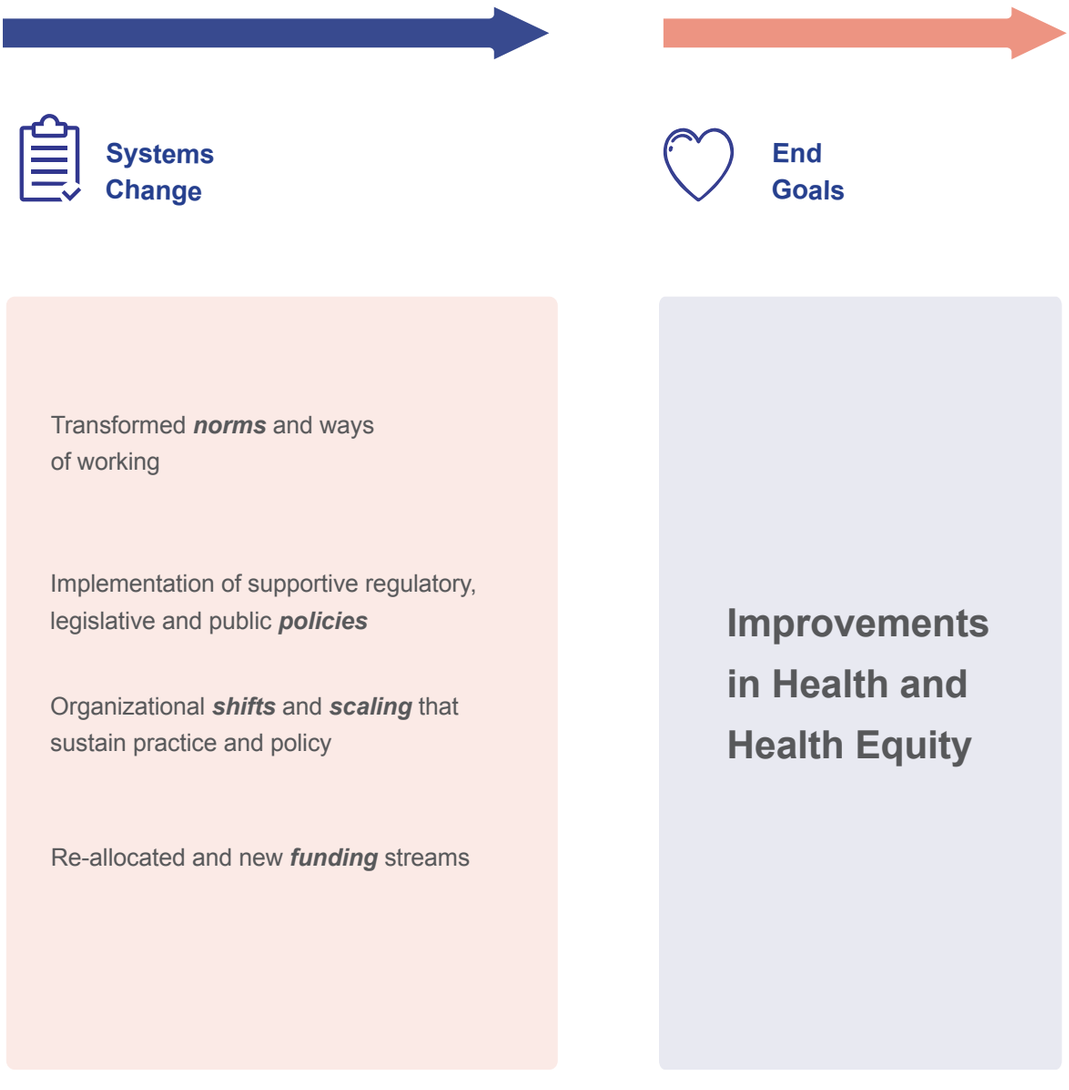
To address food insecurity and high rates of childhood obesity, Harris County BUILD partners, including HCPH, came together to leverage each of their individual strengths through a collective impact framework. In 2018, the BUILD partnership reported distributing more than 38,000 pounds of fresh produce and more than 200 food scholarship and food prescriptions for north Pasadena residents. The partnership was made possible by a backbone committee of health systems, public health, academia, and community-based organizations committed to shared goals of addressing food insecurity within a targeted area of high need.[56] An innovative aspect of this work included a health care provider writing a prescription for fresh fruit and vegetables which the patient could then take over to the "farmacy" that was on-site to get initiated in increased nutritious food intake. Over time, this has led to similar such initiatives in the community including participation at Harris Health's LBJ Hospital in 2019.[57]

Figure 1.19 Outcomes Framework



Figure 1.19 Outcomes Framework.
Source: Adapted from the BUILD Health Challenge (2018).





Conclusion

HCPH also utilizes the collective impact model (Figures 1.17, 1.18), which is a framework that brings key stakeholders together to align their vision and strategic orientation. These conditions and phases of collective impact are a powerful model to drive change across systems. Isolated impact focuses on large scale change through a single organization, but collective impact relies instead on actively coordinating and streamlining public and private partners through action and sharing of lessons learned.[54] Key to its success is shared data and information to increasingly frame issues in new, more finely detailed ways and an increased recognition of sector overlap in ways that were not previously understood. To do this, backbone organizations through formal governance structures must coordinate and facilitate open communication.

Public health or an inter-agency council for a countywide health initiative (or initiatives) can play a critical role as backbone support for a broad spectrum of stakeholders, to develop and advocate for policy with upstream root causes of health inequity, and to support the formation of broad coalitions of support. This framework can be used to address systems-level issues such as housing, transportation, violence, etc. that ultimately impact health. HCPH has already acted as a backbone for initiatives targeted towards obesity such as Healthy Living Matters.[55] No one organization or institution can fix these issues. However, public health is poised to take on a role as "community health strategist" to assist in facilitating, evaluating, and convening county and system-wide collaboration with local health partners and nontraditional partners.

While both public (including HCPH and Harris Health) and private health care partners have invested in strategic teams in health policy that aim at much needed upstream work in the community, these investments must be made strategically and in coordination with public health, so the overall system of community health is addressed. Lack of





"Without a countywide coordinated, accessible and integrated system of care, Harris County residents, especially in underserved communities, will continue to be excluded from necessary prevention and treatment services, which impacts the health and well-being of our population."

—Annalee Gulley

Director, Mental Health America of Greater Houston

3

Health Care Access and Delivery

Lack of access to health services is an oft-cited barrier to health care delivery that is not always clearly defined. The literature defines equity of access as equal access to and equal utilization of health care for those in equal need of it.[59] Access to health care services is also defined as the timely use of personal health care services to achieve the best health outcomes.[60] In this study, the authors have adapted "access" to health care by examining it through the lens of the "three A's" of access: **Availability, Acceptability, and Affordability**. For this study, **Availability** is used to describe resources and infrastructure available for health care services compounded by barriers of geographic accessibility and transportation.

Acceptability refers to the interplay of trust between resident, provider, and health system, as well as the willingness of health systems to be organized in ways that meet the constraints and preferences of the residents they serve.

Affordability refers to one's ability to pay for timely and adequate health services. This concept is cited both in the literature and in interviews with Harris County residents and stakeholders as issues prevalent within Harris County.[61] These "three A's of access" embrace the confluence of place-based factors where residents, as HCPH phrases it, "live, learn, work, worship, and play." Figure 1.20 summarizes the factors that impact health care access.[62,63,64]



Community VOICE SPOTLIGHT

"I had no insurance because I made $75 too much for Medicaid. That made me lose my home health provider and put me in a bad situation. The city offered me some help [for caregiver respite], but it was only three hours a week. Now I'm on a heart transplant list and am grateful and blessed to be on Medicare.

Being insured through Medicare gives me more personalized care because with Harris [Health] System, they have such a huge workload, it felt insufficient. I received just enough care so when I got home, I would just have another heart attack. If you don't have insurance, when you go to the ER, you don't get all the tests you need. But on the flip side, if you have insurance, they test for everything because they know they can bill for it...

Quality care looks like personalized and individualized care. I felt like I was being shuffled around in the county when I didn't have insurance because there were so many people waiting to see the doctor. The emergency room was so cramped, and if you were not having an emergency, you would sit there for more than 24 hours. If you didn't have an emergency, scheduling for appointments was so dense that you were sitting there all day for a five-minute conversation with the doctor. It was months before the follow-up tests could be scheduled. With my new hospitals, the test is done that week.

But copays still eat me up. I pay almost $400 a month just seeing doctors. Transportation is another cost. You have to pay for parking in the medical center. I can't afford to do all of this."

—Harris County Resident

Availability

Primary and Preventive Services

Despite being home to the TMC—the world's largest medical complex that boasts incredible infrastructure of care delivery and academic teaching institutions—Harris County continues to have both federally designated Medically Underserved Areas (MUAs) and Health Professional Shortage Areas (HPSAs). Although a recent report with the Episcopal Health Foundation (EHF) and others identified a large increase in the number of community clinics providing primary care in Harris County over the last decade, primary care needs continue to exist, especially in communities that have reported delaying seeing a health care provider or that do not have insurance.[65]

Nevertheless, Texas ranks 47th out of the 50 states in the number of primary care physicians relative to the total population.[66] The need is great and nearly 4,686 additional primary care physicians would be needed in Texas today just to meet the national average.[67] This primary care workforce shortage is compounded by the fact that one out of four licensed physicians in Harris County do not accept Medicare or Medicaid (Table 1.3).[68] The new addition of the University of Houston Medical School (scheduled to admit students in the fall of 2020) is a promising development along with existing medical schools within the area help to alleviate this issue.[69] The lack of other health professionals such as dentists, veterinarians, sanitarians, outreach workers and nurses – especially in the public sector – is also important to examine in overall health needs context of a community such as Harris County.

Traditionally, there are three levels of prevention: primary, secondary, and tertiary. Primary prevention focuses on intervention before health effects occur. Secondary prevention focuses on screening to identify disease early. Tertiary prevention focuses on the management of disease to slow or stop the progression of a disease one already has. Primary care resources are vital for preventing disease progression, severe quality of life deterioration, and early death. Primary care includes health promotion, disease prevention, health maintenance, counseling, patient education, and diagnosis and treatment of illnesses in a variety of health care settings.[70]

FIGURE 1.20 Factors that Impact Health Care Access

Personal Characteristics	Community Characteristics
Predisposing Characteristics • Socioeconomic factors – poverty • Insurance status/lack of insurance/insurance acceptability by providers • Language barrier • Limited knowledge • Low motivation • Fear or stigma • Cultural barriers	**Structure** • Office accessibility • Limited network • Clinic-to-clinic communication gaps • Shortage of personnel and lack of clinic-hospital affiliation • Limited availability of pro bono providers
Enabling Factors • Income • Health insurance coverage • Time • Transportation	**Process** • Wait time • Difficulty arranging appointment
Perception of Need • Overall health status • Presence of disease • Perception of quality of life	



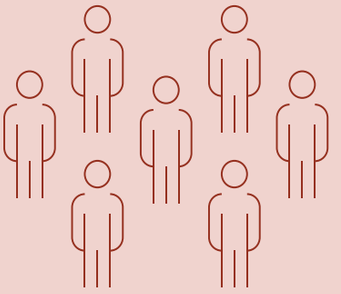


Figure 1.20 Factors that Impact Health Care Access, Personal vs. Community Characteristics.
Source: Adapted from Cook et al. (2007); Ezeonwu (2018); Nakamura et al. (2019).

To visualize availability of health care delivery within Harris County, data was pulled from local, state, and national resources and overlaid to indicate and suggest areas of Harris County that are especially in need of greater infrastructure. Data from the federal Health Resources and Services Administration (HRSA) was used to visualize areas in Harris County that are designated as MUAs and populations as well as areas with HPSAs (see Figure 1.21). These federally designated locations weigh various measures such as having too few primary care providers, high infant mortality, high poverty, and a high percentage of older residents to name a few.

Federally Qualified Health Centers (FQHCs) are low cost and sliding scale clinics that receive federal funding and offer comprehensive health services such as preventive health services, dental services, mental health, transportation services, and specialty care in areas that are underserved.

Table 1.3 Texas Medical Board Licensed Physicians

	Number	Percentage
Does not Accept Medicare/Medicaid	3,353	26%
Accepts Medicare/Medicaid	9,378	74%
Total	12,731	100%

Table 1.3 All Texas Medical Board Licensed Physicians, Harris County, TX, 2019.
Source: Licensed Physician Database, Texas Medical Board, 2019.

Figure 1.21 MUAs/MUPs and Primary Care HPSAs

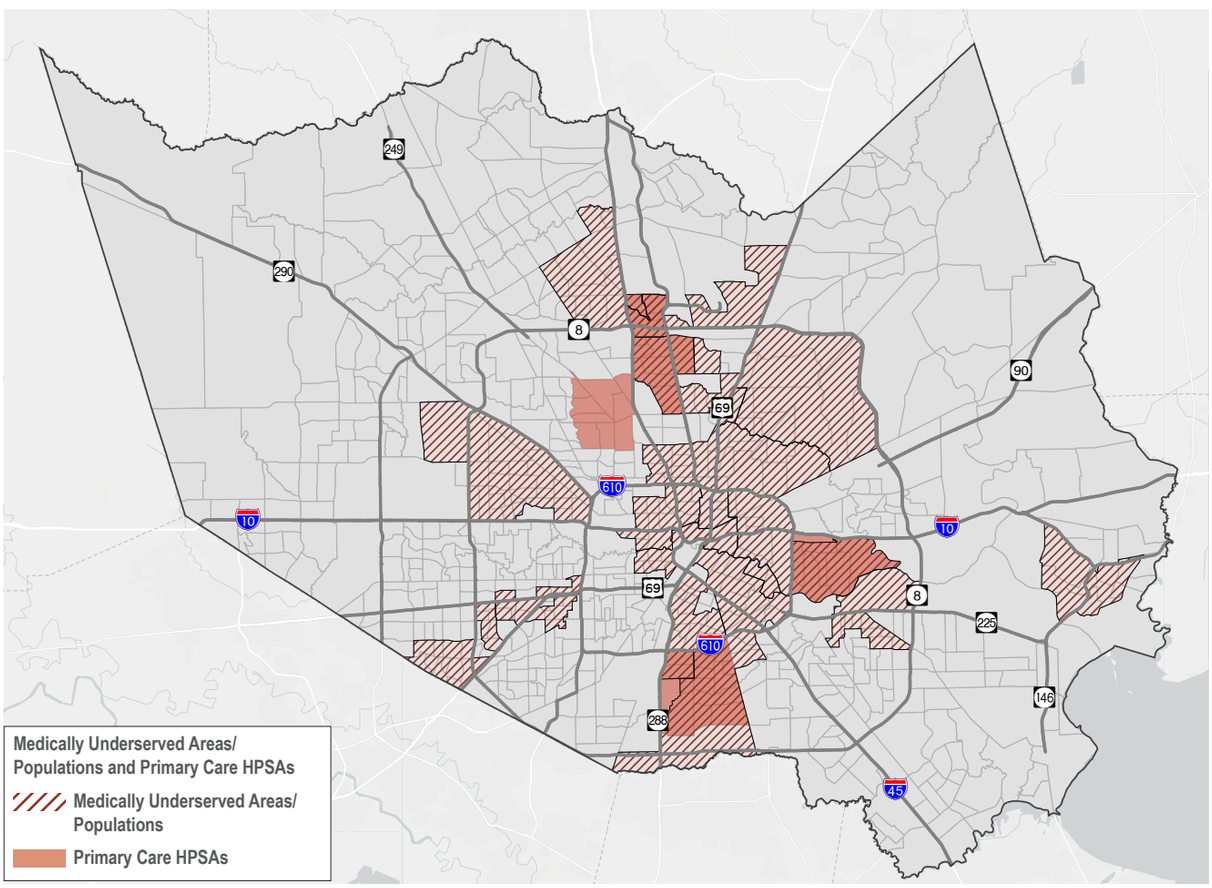
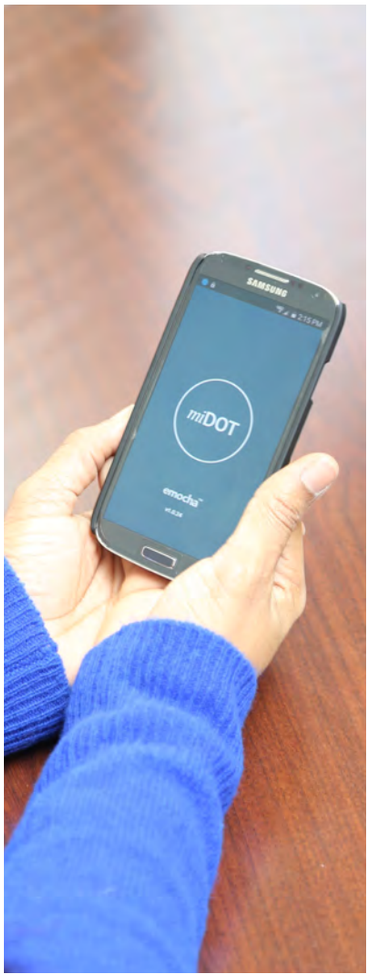


Figure 1.21 Medically Underserved Areas/Populations and Primary Care Health Professional Shortage Areas (HPSAs), Harris County, TX.
Source: Health Resources & Services Administration.



In Harris County, there are 101 FQHC sites classified by HRSA, and five FQHC Look-Alikes that also provide comparable, comprehensive health services but do not receive the same federal funding as FQHCs (Table 1.4).[71] These sites tend to focus on the urban core of Harris County (Figure 1.22). In addition to other health care infrastructure changes, the closing of the East Houston Regional Medical Center hospital on the east side as well as the Riverside Hospital closure in 2015 in the Third Ward, contributed to the pressing shortage of health care infrastructure.

Table 1.4 Local Health Facilities Providing Preventive Services

Facility Type	Number
Selected Local Government Health Facilities	**36**
Harris County Public Health Facilities	2
Houston Health Department Facilities	6
Harris Health Facilities	28
FQHCs and FQHC Look-Alikes	**106**
FQHCs	101
FQHC Look-Alikes	5

Table 1.4 Selected Local Health Facilities That Provide Preventive Health Services, Harris County, TX, 2019.
Source: Houston Health Department, City of Houston, 2019; Harris County Public Health, 2019; Harris Health System, 2019; Health Resources & Services Administration, 2019.

Figure 1.22 Adults Without Health Insurance (%)

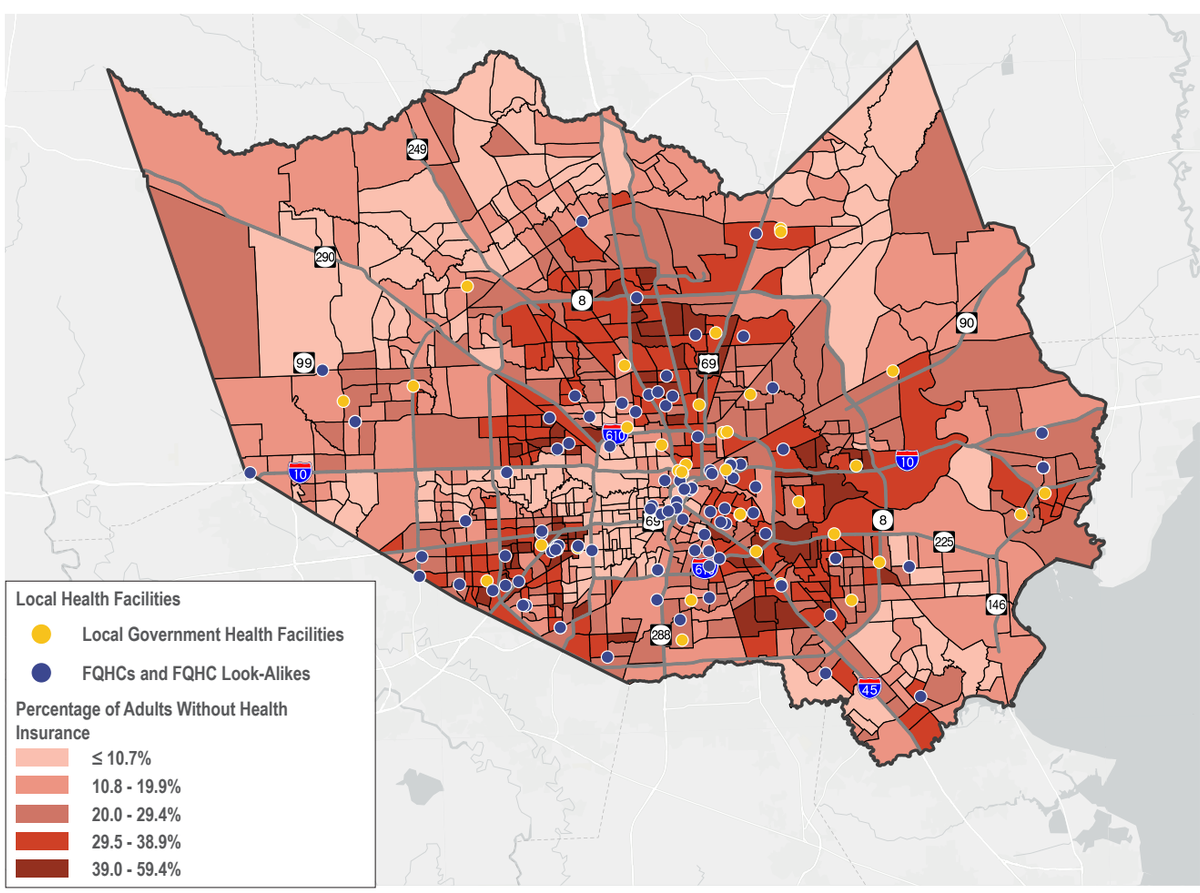


Figure 1.22 Selected Local Health Facilities and the Percentage of Adults Without Health Insurance by Census Tract, Harris County, TX, 2016.
Source: Houston Health Department, City of Houston, 2019; Harris County Public Health, 2019; Harris Health System, 2019; Health Resources & Services Administration, 2019; American Community Survey, Census Bureau, 2012-2016.

"Before we define what we should be building, we should do an assessment of what already exists."

—Stephen Williams, Director, Houston Health Department

Local government health centers through Harris Health, HCPH, and HHD also offer preventive health services to fill in gaps in the availability of care for uninsured and underinsured residents. As seen in Figure 1.23, which includes public-funded preventive health clinics in addition to public health facilities such as WIC clinics and multi-service centers, there is overlap and great potential between Harris Health, HCPH, HHD, and Harris Center that all provide some level of health services and prevention opportunities. By leveraging the facility infrastructure of each agency and utilizing potential opportunities for co-location of services, it is possible for health focused local government agencies to rely on their sisters and maximize the impact for shared populations in poor health.

Investment into both "brick and mortar" infrastructure and rapidly deployable, flexible alternatives to care such as through "High Tech/High Touch" and *Health Hub* opportunities can increase the availability of resources, especially in times of an emergency. While health care infrastructure investment cannot change health outcomes of communities within Harris County alone, it is an important element for ensuring provision of health care delivery within these very communities.

These maps on availability offer insight into areas that may lack health services that could be bolstered by new health infrastructure such as clinics and hospitals, especially near areas with dense population and poor health outcomes explored later in this study. It is estimated that building additional hospitals in Harris County could cost up to $2 million per bed.[72]

Figures 1.24 and 1.25 show two types of infrastructure needs: areas where the growing population has outpaced the health care infrastructure and areas where unaddressed health disparities warrant additional infrastructure investment. It is important for policymakers to balance several considerations: the opportunity for greater social, fiscal, and health impact for disproportionately affected populations as well as population density, growth, and the diversity of Harris County. **In other words, some communities need investment due to a growing population and others need investment due to worsening health outcomes.**

Figure 1.23 Two Mile Radius to Local Government Health Facilities

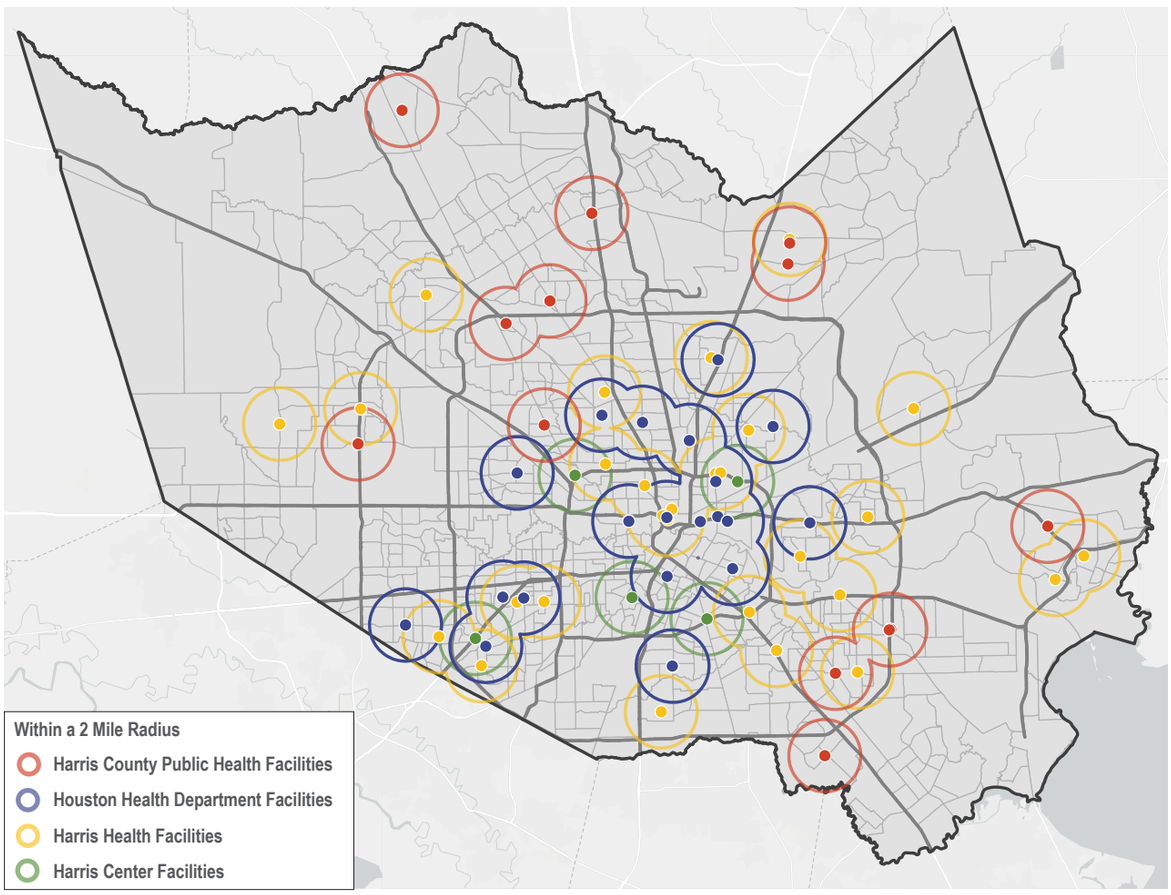


Figure 1.23 Areas Within a Two Mile Radius to Local Government Health Facilities, Harris County, TX, 2019.
Source: Houston Health Department, City of Houston, 2019; Harris County Public Health, 2019; Harris Health System, 2019; The Harris Center for Mental Health and IDD, 2019.

Figure 1.24 Two Mile Radius to FQHCs/FQHC Look-Alikes and Population Density

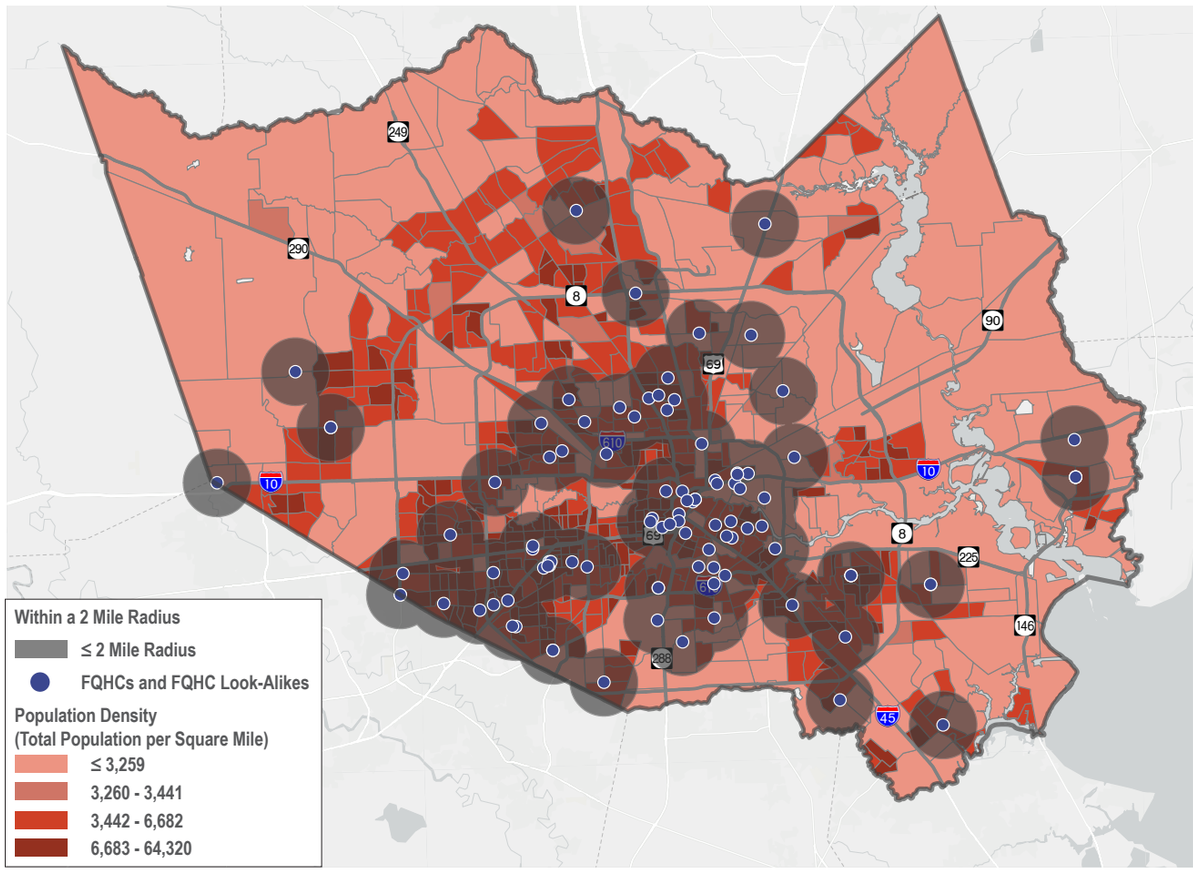


Figure 1.24 Areas Within a Two Mile Radius to FQHCs/FQHC Look-Alikes and Population Density, Harris County, TX, 2018.
Source: Health Resources & Services Administration 2019; Esri Demographics, 2018.

Figure 1.25 Two Mile Radius to FQHCs/FQHC Look-Alikes and SVI

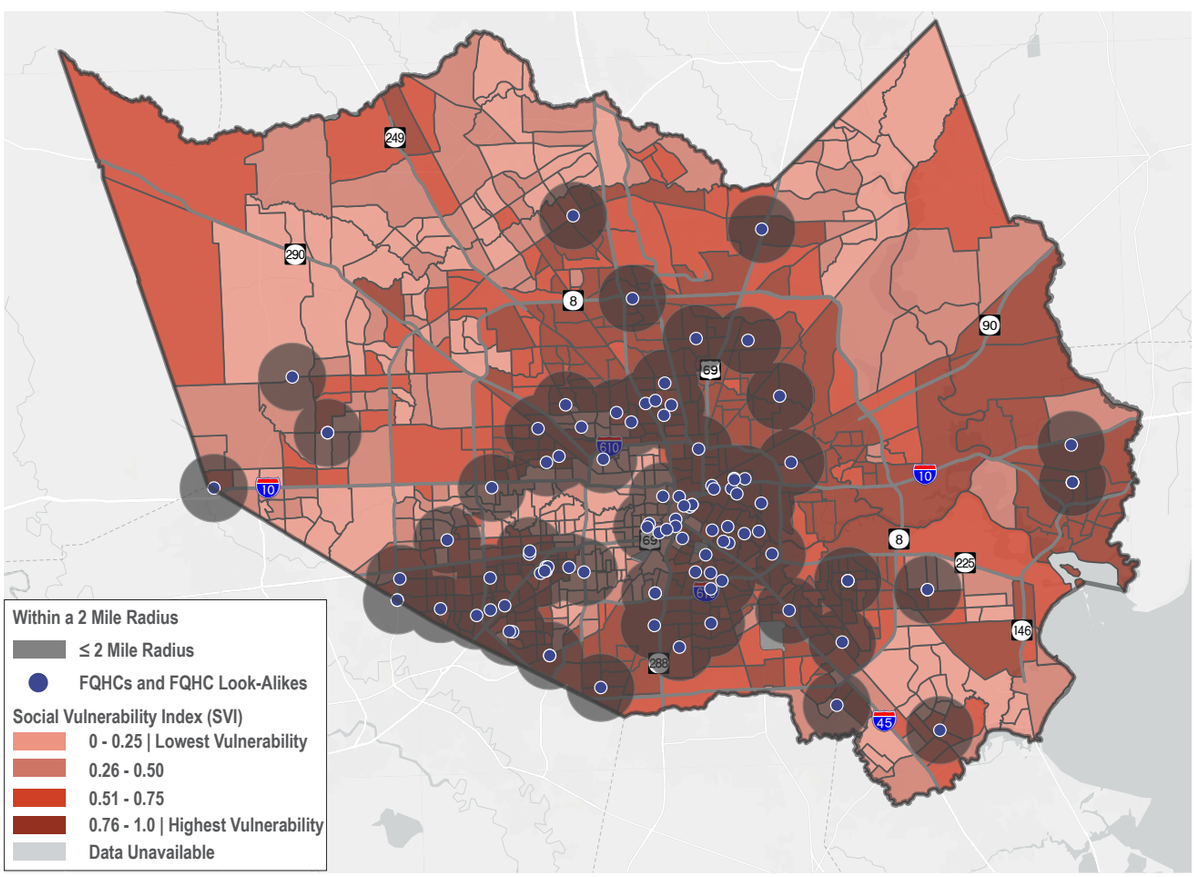


Figure 1.25 Areas Within a Two Mile Radius to FQHCs/FQHC Look-Alikes and Social Vulnerability Index, Harris County, TX, 2016.
Source: Health Resources & Services Administration, 2019; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Specialty Care

Deficiencies in access to secondary or specialty care remains a significant issue. Specialty care is medicine that focuses on a specific area of disease or the body. Examples include: heart disease, cancer, and mental health. In Harris County, safety net facilities like Harris Health or FQHCs often refer specialty care needs to private hospitals and physicians who offer charity care due to capacity limitations in specialty hospital inpatient and outpatient care. Private hospital systems that offer charity care programs on a voluntary basis or as required for tax exemption status (in the case of nonprofits) bear the financial burden of providing these services.[73] Even among those who are insured, many residents experience delay in accessing specialty care due to costs or limited availability of appointments. Some residents indicate these delays may mean scheduling appointments months in advance. Additionally, while a provider may accept Medicaid/Medicare, they may not be accepting new patients.

A report by the EHF found that the most specialty care needs that were referred by both Harris Health and FQHCs included oral surgery, gynecology, otolaryngology, gastroenterology, cardiology, optometry, ophthalmology, urology, radiology, physical therapy, dermatology, orthopedic/orthosurgery, audio/speech therapy, maternal-fetal medicine, mammography, and nephrology.[74] Figure 1.26 shows the location of licensed specialty physicians (that accept Medicare/Medicaid) in one or more of these specialty areas and the percent of adults who reported the highest rates of delayed specialty care.

"Houstonians live in an intertwined community, where the health of the least of us affects all of us."

—Dr. Vivian Ho, Health Economist, Rice University

Figure 1.26 Specialty Physicians and Adults Who Delayed Care (%)

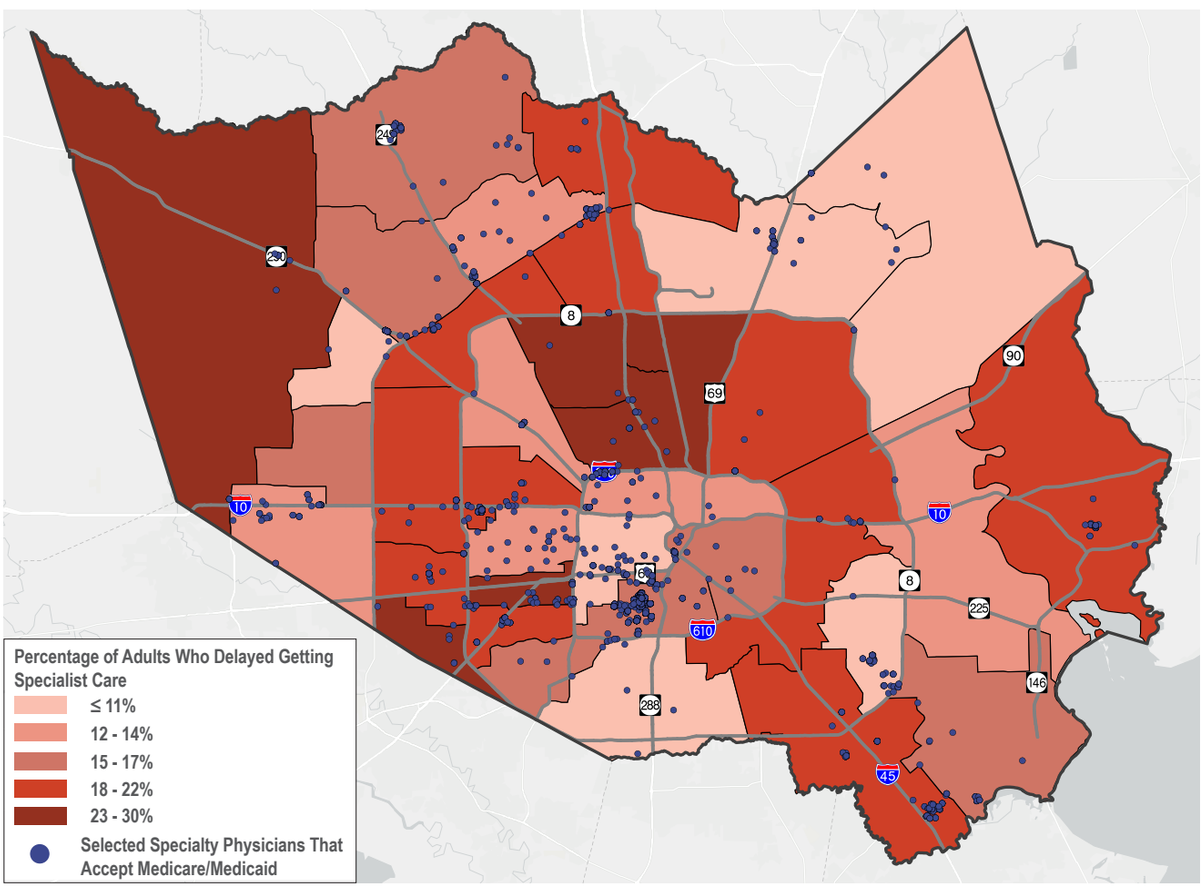


Figure 1.26 Selected Specialty Physicians That Accept Medicare/Medicaid and the Percentage of Adults Who Delayed Getting Specialist Care by PUMA, Harris County, TX, 2018.

Source: Licensed Physician Database, Texas Medical Board, 2019; Health of Houston Survey, The University of Texas School of Public Health, 2018.

Mental Health

Currently, many children and youth experience their first behavioral health care encounter within a juvenile justice facility or emergency room–not where an initial encounter should be taking place.[75] The current public mental health care system is a mix of government, nonprofit, and for-profit agencies, yet the mental health infrastructure is sorely lacking in communities with high needs (Figure 1.27).

Within Harris County there are approximately 206 facilities that provide some form of mental and/or behavioral health services, including 30 mental health facilities, 66 substance abuse treatment centers, and 18 private for-profit opioid treatment centers.[76] FQHCs, school-based health centers, and the Michael E. DeBakey Veterans Affairs Hospital (VA Hospital) also provide limited mental health services. Public agencies that comprise aspects of the mental health system include the Harris Center, the Harris County Jail, Harris Health, Harris County Psychiatric Center, Harris County Probates Courts, and the Rusk State Hospital.[77]

A 2017 Houston Endowment led system assessment of mental health services in Harris County found that most mental and behavioral health care is delivered at the specialty care level, and there is a need for mental health to be incorporated into integrated primary care to reduce barriers to accessing mental health care when needed.[78] Primary care is the setting in which Americans receive most of their health and behavioral health care. Frequent contacts between primary care physicians and their patients make primary care an ideal setting for suicide prevention interventions. In fact, people who die by suicide are more likely to have seen a primary care physician in the previous month before their death than any other health care provider.[79]

It is not just the availability of mental health services, it is also the distribution and accessibility to those services that ultimately drives less than optimal mental health-related health outcomes in the community, as exemplified in Figure 1.28. To begin addressing these suboptimal outcomes, Harris County needs to invest in building the capabilities and capacities of existing mental health infrastructure and encourage improved communication, coordination, and collaboration amongst all stakeholders involved in improving mental health. However, to achieve truly optimal mental health outcomes, **mental health needs to be an integrated component of all health services, including clinical, social, and public health.**[80]

"Behavioral health/mental health remains segregated as a specialty - 'That's your patient, not ours' and the stigma underlying this is an issue that Harris Center encounters with health care."

-Wayne Young, Executive Director, The Harris Center

Figure 1.27 Mental Health Facilities and SVI

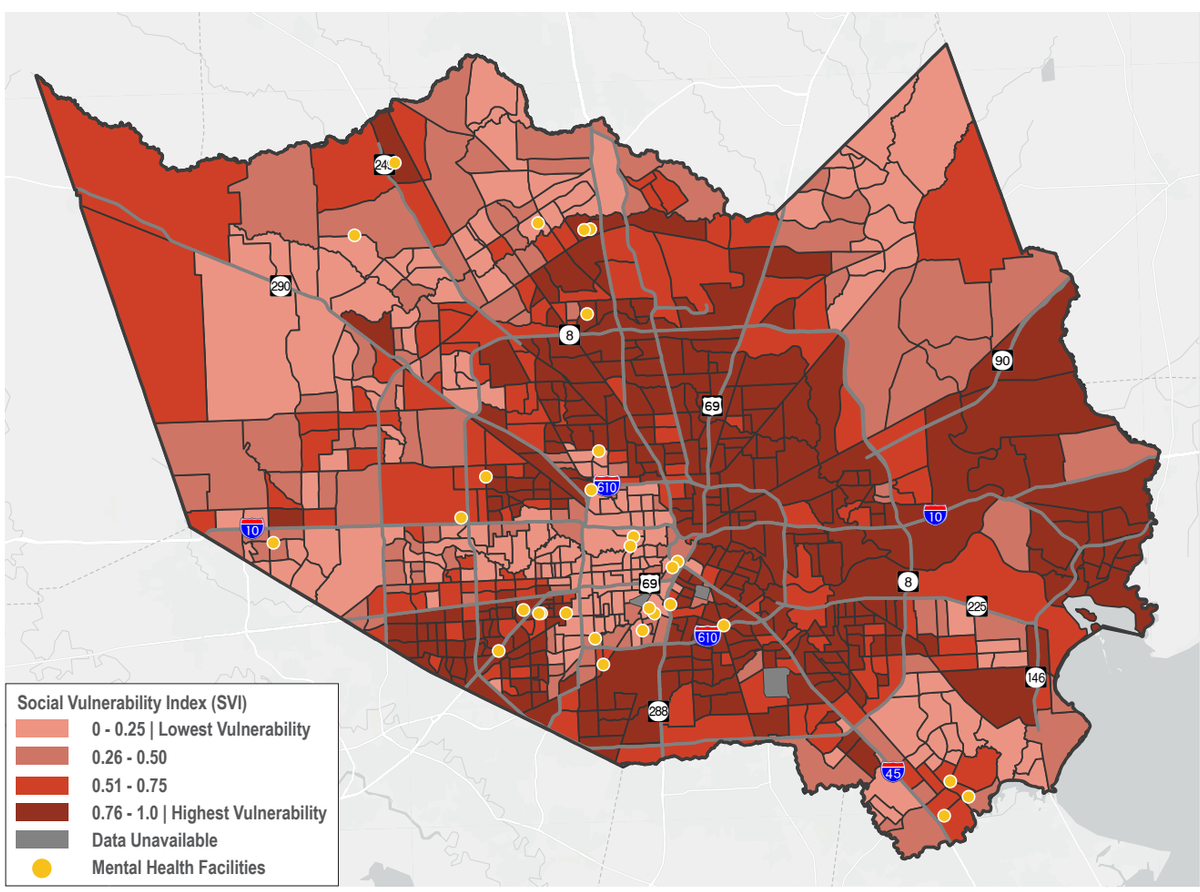
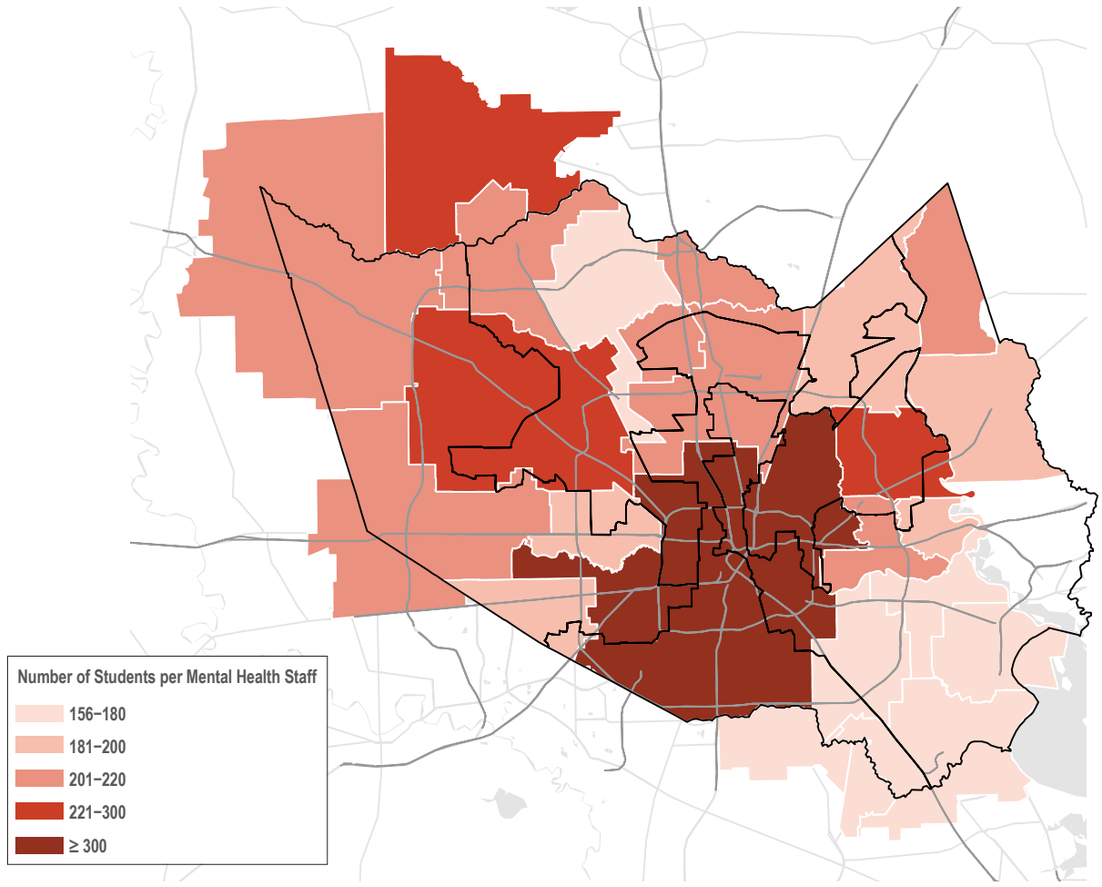


Figure 1.27 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
Source: Substance Abuse and Mental Health Services Administration, US Department of Health and Human Services; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Figure 1.28 Mental Health Staff in School Districts



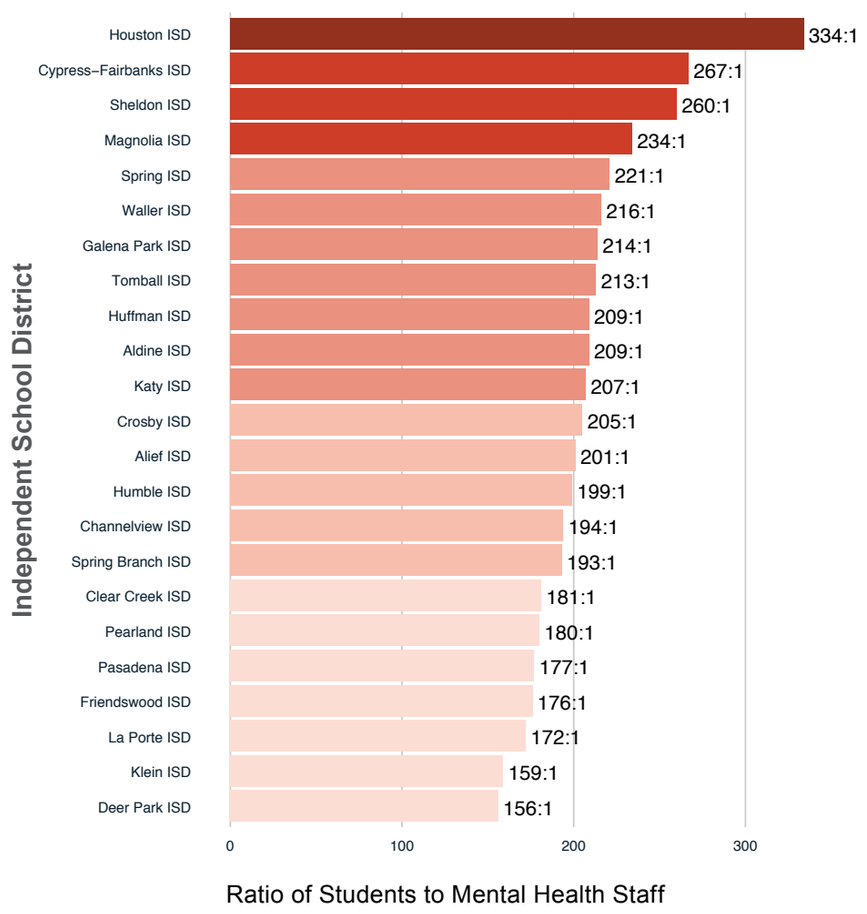


Figure 1.28 Number of Students per Mental Health Staff by Independent School District, Harris County, TX, 2017-2018.
Source: Texas Education Agency, 2017-2018.

Hospitals, Trauma Centers, and Emergency Medical Services

Harris County's hospital infrastructure is expansive, and the county is home to the world's largest, most innovative medical center, the TMC. Hospitals provide a community with easy access to many clinical services that are generally available any time of the day. However, this high service-level comes at a cost. Hospitals require significant and sustained investment; policymakers need to balance such investment in health care infrastructure against investments in tools that improve population health (Figures 1.29, 1.30, 1.31; Table 1.5).

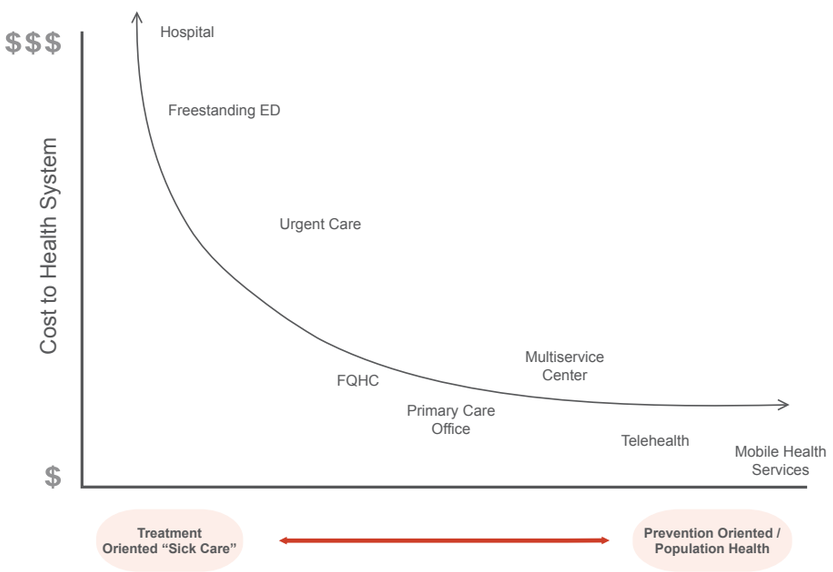


Figure 1.29 HCPH Conceptual Taxonomy of Health Infrastructure.

Figure 1.30 Hospital Locations and Five-Year Population

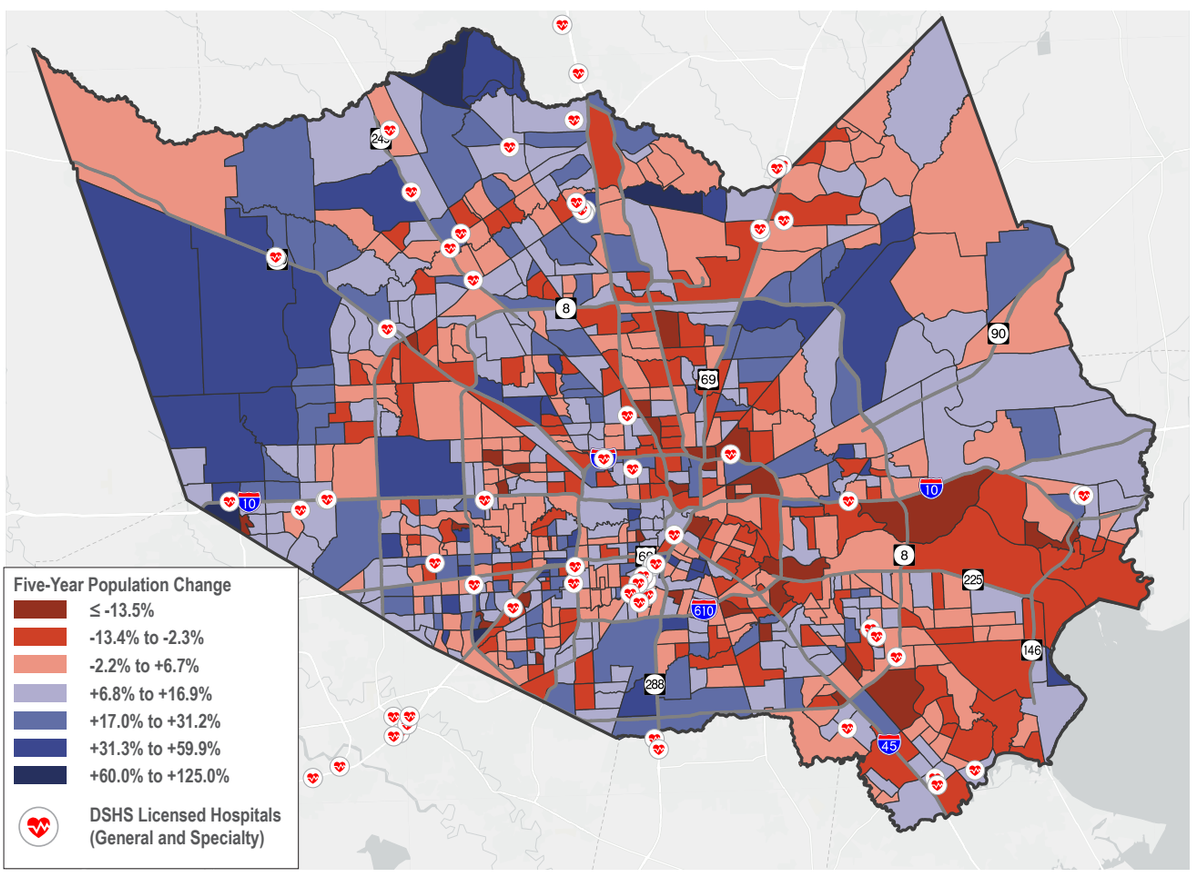


Figure 1.30 Hospital Locations and Five-Year Population Change by Census Tract, Harris County, TX, 2013 vs. 2017.
Source: American Community Survey, US Census Bureau, 2013/2017; Health and Human Services Commission, Texas Department of State Health Services, 2019.

Table 1.5 Hospitals by PUMA

PUMA	DSHS Licensed Hospital (General and Specialty)	
Alief - Westchase	HCA Houston Healthcare West Healthbridge Children's Hospital-Houston Ltd	
Baytown- Highlands	Houston Methodist Baytown Hospital Altus Baytown Hospital, Baytown Medical Center	
Bellaire - COH Southwest	Memorial Hermann Southwest Hospital	
Champions Area	Providence Hospital of North Houston LLC	
Clear Lake - Webster	Houston Physicians Hospital Cornerstone Specialty Hospitals Clear Lake HCA Houston Healthcare Clear Lake Kindred Hospital Clear Lake	Pam Rehabilitation Hospital of Clear Lake Kindred Rehabilitation Hospital Clear Lake Memorial Hermann Southeast Hospital
Cypress - Katy	Memorial Hermann Katy Hospital Memorial Hermann Cypress Hospital	
East Little York - Settegast	Harris Health System Lyndon B Johnson Hospital	
Eldridge - Cinco Ranch	Memorial Hermann Rehabilitation Hospital Katy Houston Methodist Continuing Care Hospital	Houston Methodist West Hospital Texas Children's Hospital West Campus
Galena Park - Jacinto City	Ad Hospital East LLC	
Greater Hobby - Edgebrook	Pine Valley Specialty Hospital	
Gulfton - North Sharpstown	Cornerstone Specialty Hospitals Bellaire Altus Houston Hospital, Celestial Hospital, Odyssey Hospital	First Surgical Hospital Memorial Hermann Orthopedic and Spine Hospital
Humble - Atascosita	Encompass Health Rehabilitation Hospital of Humble Kindred Rehabilitation Hospital Northeast Houston	Memorial Hermann Northeast SE Texas ER And Hospital Townsen Memorial Hospital
Jersey Village - Willowbrook	Kindred Hospital Houston NW	
Medical Center - MacGregor	The Woman's Hospital of Texas Baylor St. Luke's Medical Center - McNair Campus Texas Orthopedic Hospital Shriners Hospitals for Children CHI St. Luke's Health Baylor College of Medicine Medical Center TIRR Memorial Hermann Texas Children's Hospital Houston Methodist Hospital	Harris Health System Ben Taub Hospital Kindred Hospital Houston Medical Center Memorial Hermann - Texas Medical Center Cornerstone Specialty Hospitals Medical Center HCA Houston Healthcare Medical Center HCA Houston Healthcare Specialty Hospital Medical Center UGH Pain & Spine
North Cypress - Fairbanks	Encompass Health Rehabilitation Hospital of Cypress HCA Houston Healthcare North Cypress	
North FM 1960 - East 249	Houston Methodist Willowbrook Hospital St. Luke's Hospital at The Vintage Encompass Health Rehabilitation Hospital The Vintage First Texas Hospital	HCA Houston Healthcare Northwest TOPS Surgical Specialty Hospital United Memorial Medical Center North Houston Kindred Hospital Spring
Pasadena	St. Luke's Patients Medical Center Surgery Specialty Hospitals of America Southeast Houston HCA Houston Healthcare Southeast	
Pasadena (South) - LaPorte	Houston Methodist Clear Lake Hospital Kindred Hospital Bay Area	
South Acres Homes - Northline	United Memorial Medical Center	
Spring - The Woodlands	CHI St. Luke's Health - Springwoods Village	
Spring Valley - COH West	Memorial Hermann Memorial City Medical Center Trinity Hospital	
The Heights - Fifth Ward	St. Joseph Medical Center in The Heights The Heights Hospital Kindred Hospital The Heights Memorial Hermann Greater Heights Hospital	
Tomball - The Woodlands (SW)	Memorial Hermann Tomball Hospital Spring Excellence Surgical Hospital LLC HCA Houston Healthcare Tomball Kindred Hospital Tomball	

Table 1.5 DSHS Licensed Hospitals by PUMA, Harris County, TX, 2019.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019.

"As a community that has the best medical care in the world, we need to translate that to all communities that need the most care."

—Dr. Peggy Smith, Director, Baylor Teen Clinic

Trauma centers offer higher levels of emergency care than other non-trauma hospitals. There are three Level I Trauma Centers (including one pediatric) in Harris County, and all are in the TMC. There is one Level II Trauma Center located in Harris County (though there are additional Level II Trauma Centers in Conroe and the Woodlands). There are nine Level III Trauma Centers dispersed within Harris County. Hermann Hospital at the TMC is the only designated burn hospital within Harris County (Table 1.6, Figure 1.32).

Timely access to these trauma centers is critical to saving lives. Several communities in Harris County are more than 15 minutes from a Trauma Center (Figures 1.33 and 1.34). Like with preventative care services, some communities would benefit from more timely access to Trauma Centers due to population growth and others due to growing social vulnerability. Emergency medical services (EMS) for Harris County must cover 1,778 square miles of sprawling urban and suburban landscape, and are divided into several agency models:

- **Fire Department Model -** Communities with EMS agencies embedded in the city fire departments (Houston Fire Department, etc.).
- **Third Service Model -** A third service provides EMS in the community. In those communities, there is a fire department, police department, and EMS department. EMS services do not fall under fire or police but are incorporated as an independent department into the governmental structure of the community (La Porte EMS and Nassau Bay EMS, etc.).
- **Private Model -** Communities which have contracted their 9-1-1 EMS response to an outsourced for-profit agency. (Acadian EMS contracting with Pasadena and Webster, etc.)
- **Nonprofit Model -** Areas that have been chartered as Emergency Service Districts (ESDs) in which the municipality or Municipal Utilities Districts (MUDs) contracts with a 501(c)(3) nonprofit.

Figure 1.31 Distance to Hospitals

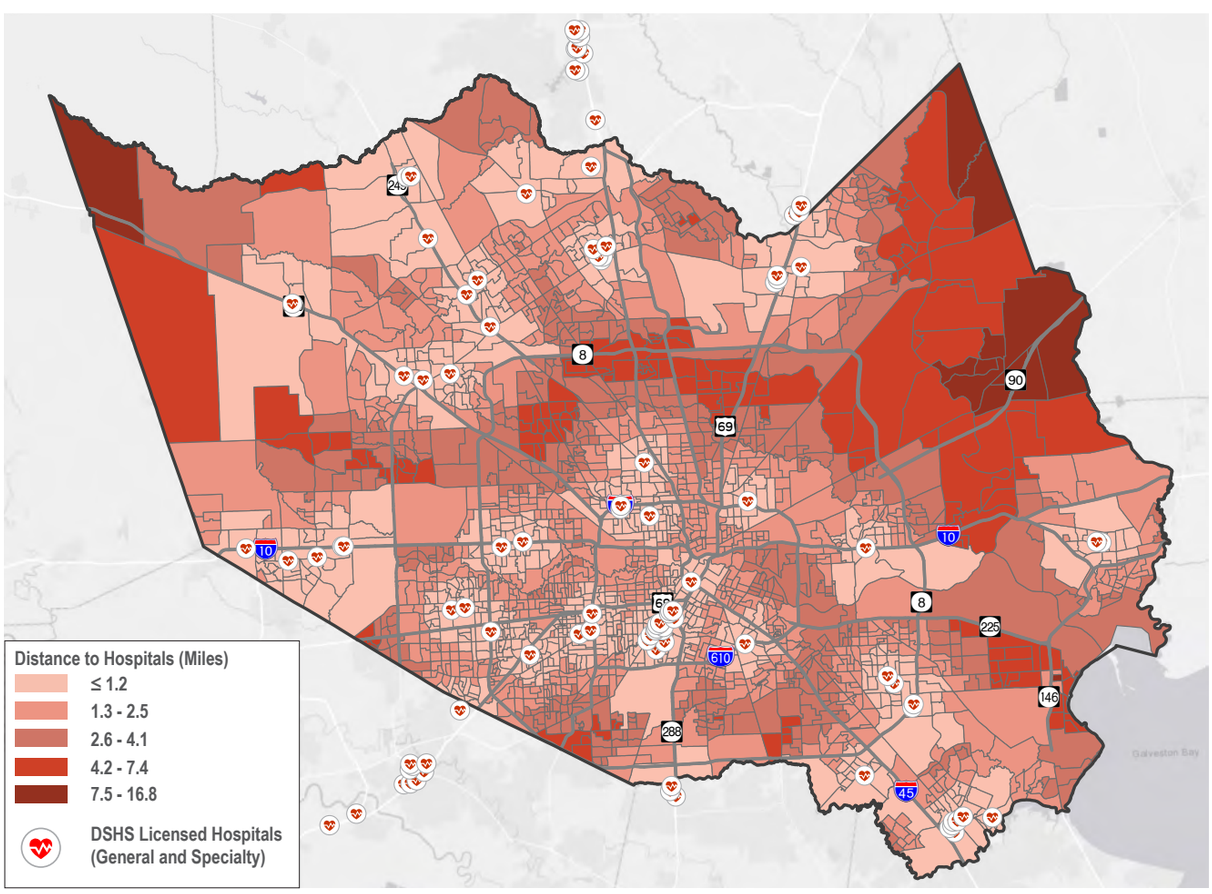


Figure 1.31 Distance to DSHS Licensed Hospitals by Census Block, Harris County, TX, 2019.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019.



Table 1.6 DSHS Licensed Trauma Facilities

Level	PUMA	DSHS Licensed Trauma Facility
Level I	Medical Center - MacGregor	Harris Health System Ben Taub Hospital Memorial Hermann - Texas Medical Center Texas Children's Hospital
Level II	Clear Lake - Webster	Clear Lake Regional Medical Center
Level III	Clear Lake - Webster Downtown - East End East Little York - Settegast Jersey Village - Willowbrook Bellaire - COH Southwest North FM 1960 - East 249 Pasadena The Heights - Fifth Ward Tomball - The Woodlands (SW)	Memorial Hermann Southeast Hospital St. Joseph Medical Center Harris Health System Lyndon B Johnson Hospital Cypress Fairbanks Medical Center Hospital Memorial Hermann Southwest Hospital Houston Northwest Medical Center Bayshore Medical Center Memorial Hermann Greater Heights Hospital Tomball Regional Medical Center
Level IV	Alief - Westchase Cypress - Katy Medical Center - MacGregor South Acres Homes - Northline The Heights - Fifth Ward	West Houston Medical Center Memorial Hermann Katy Hospital The Woman's Hospital of Texas United Memorial Medical Center St. Joseph Medical Center in the Heights

Table 1.6 DSHS Licensed Trauma Facilities (Levels I, II, III, IV) by PUMA, Harris County, TX, 2018.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018.

Figure 1.32 Distance to Trauma Facilities

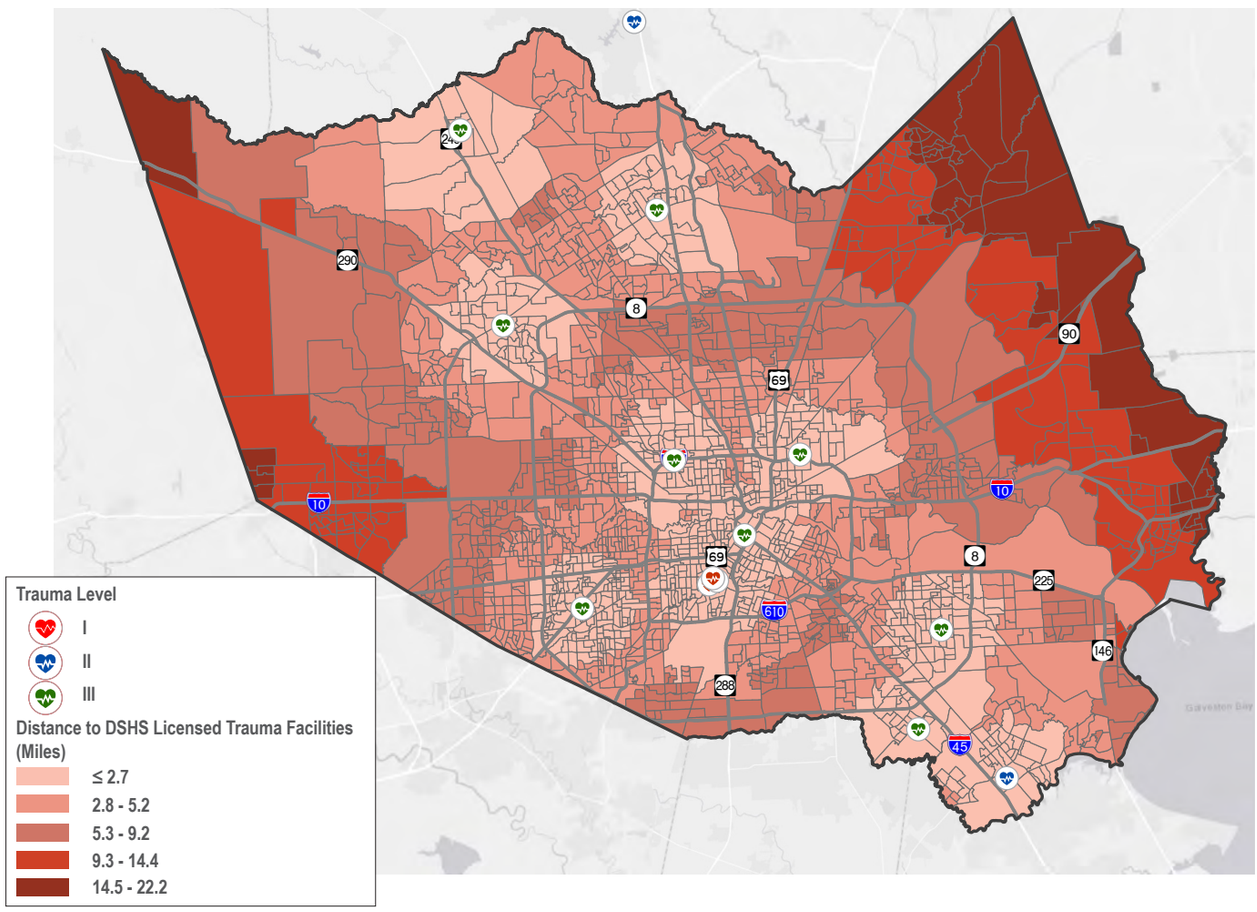


Figure 1.32 Distance to DSHS Licensed Trauma Facilities (Levels I, II, III) by Census Block, Harris County, TX, 2018.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018.

Figure 1.33 Driving Distance to Trauma Facilities and Population Density

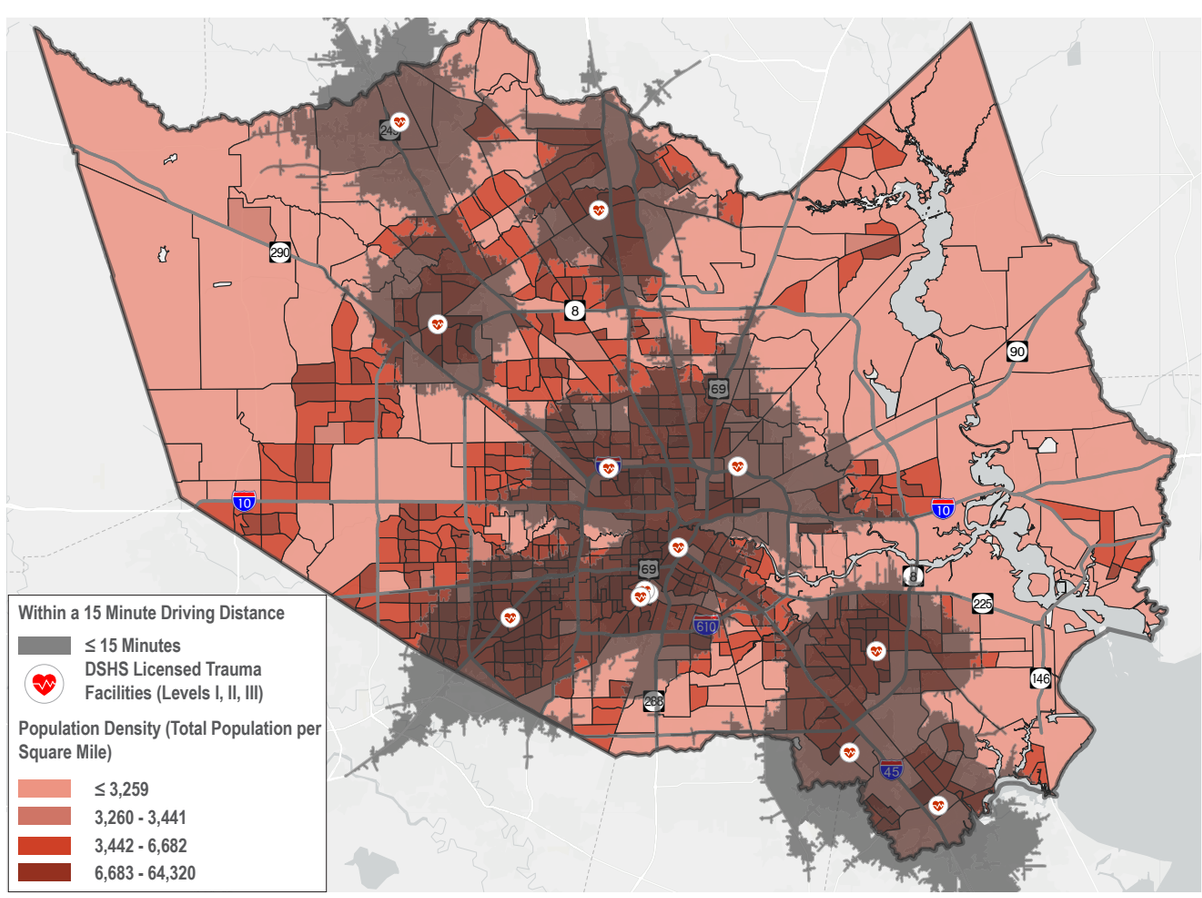


Figure 1.33 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Population Density, Harris County, TX, 2018.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018; Esri Demographics, 2018.

There are 34 EMS agencies within Harris County that perform 9-1-1 responses (Figure 1.35). These 34 agencies have approximately 306 licensed ambulances. Most of these ambulances are licensed as Basic Life Support with Mobile Intensive Care Unit (MICU) capabilities. As of August 2019, there were a total of 123 distinct EMS agencies with 888 ambulances licensed by DSHS within Harris County that perform both 9-1-1 and non-emergency calls. These additional agencies are typically for-profit ambulance transfer companies. Ambulance companies that pick-up and transfer patients within the city limits of Houston must have a permit issued by the HHD. All ambulance services must have a medical director that dictates care via protocols.

In Harris County, there are several dispatch centers to answer 9-1-1 calls for emergency services. These dispatch centers generally operate independently of one another. During interviews of EMS agencies, most reported that they had difficulty communicating with other agencies that use different dispatch and/or encryption systems during mutual aid or disaster situations. Dispatchers can "bridge" or "patch" radios from different systems on a mutual talk group channel in the dispatch center for communications interoperability. Problems arise when the dispatch center is unable to make the patch as a result of being inundated with calls, hindering communication among mutual aid partners. This again underscores the need to create a culture of stronger communication, collaboration, and coordination among agencies involved in health.

One stakeholder shared the experience of a Harris County resident who could not access a clinic. Even though the clinic collaborated with transportation authorities for bus passes, he lived 30 minutes away from a bus stop. Road construction and incomplete sidewalks made the journey all the worse and was only mended after the clinic offered a private ride sharing service, Lyft. If tasked as a "community health strategist," public health can convene and coordinate unique solutions to addressing issues of health care access.

There is a need for community-based solutions to augment and secure medical care solutions for resolving health issues. Community-based solutions do not replace clinically-based solutions but support and strengthen what is happening within the four walls of the clinic. **The solutions to health care access do not lie only in reform of the health care delivery system. Rather, solutions to health care access must be as multifaceted and complex as the issues that affect it.**

If tasked as a "community health strategist," public health can convene and coordinate unique solutions to addressing issues of health care access.

Figure 1.34 Driving Distance to Trauma Facilities and SVI

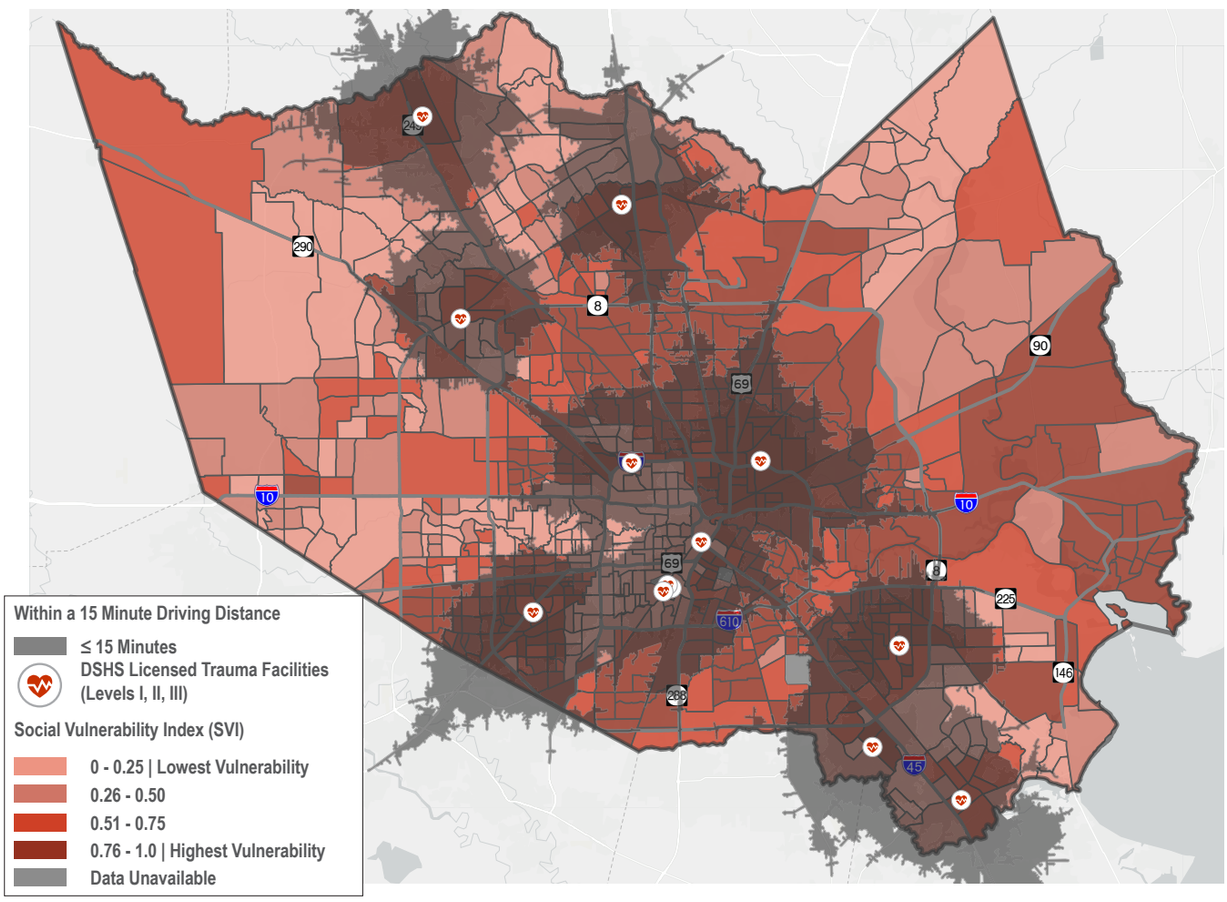
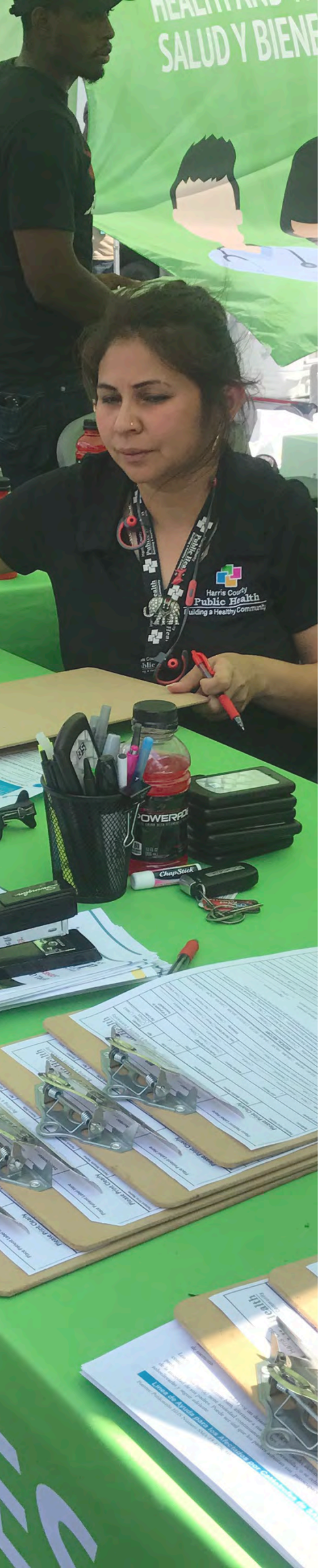


Figure 1.34 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Social Vulnerability Index, Harris County, TX, 2016.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.



Acceptability

Acceptability refers to the interplay of trust among resident, provider, and health system and willingness of health systems to be organized in ways that meet the constraints and preferences of the residents they serve.[81] Harris County residents juggle overwhelming pressures and responsibilities. Health systems must be creative in committing to meeting the needs of population it serves.

Working Harris County residents often encounter challenges to accessing preventive care outside of normal working hours. This is especially difficult for many residents in low to median income positions that offer inflexible schedules. More than half of Harris County free/low-cost/sliding scale clinics were only open during regular business hours Monday to Friday (52%) (Table 1.7). In addition, for over a third of these facilities (35%), a patient either had to request hours of operation or schedule an appointment, which may pose as additional barriers for under- and uninsured populations.[82]

Table 1.7 Hours of Operation

	Number	Percentage
Monday - Friday	53	52%
Monday - Saturday	13	13%
7 days	4	4%
Other	21	21%
By appointment only	11	11%
Total	102	100%

Table 1.7 Hours of Operation for Low Cost and Sliding Scale Clinics, Harris County, TX, 2019.
Note: Due to rounding, total adds to 101%.
Source: NeedyMeds, 2019.

Table 1.8 Languages Offered

	Number	Percentage
English	45	44%
English and Spanish	53	52%
English and others by translation service (Cantonese, Mandarin, Swahili, Korean, Vietnamese, Arabic, Spanish)	4	4%
Total	102	100%

Table 1.8 Languages Offered in Low Cost and Sliding Scale Clinics, Harris County, TX, 2019.
Source: NeedyMeds, 2019.

Table 1.9 Uninsured Population

Geography	All Ages	Under 19	19-64	65+
United States	10.5%	5.7%	14.8%	0.9%
Texas	18.2%	11.0%	24.8%	1.9%
Harris County	21.2%	12.1%	28.0%	3.4%
City of Houston	24.1%	12.9%	32.1%	3.4%

Table 1.9 Uninsured Population, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Figure 1.35 EMS Calls and Population

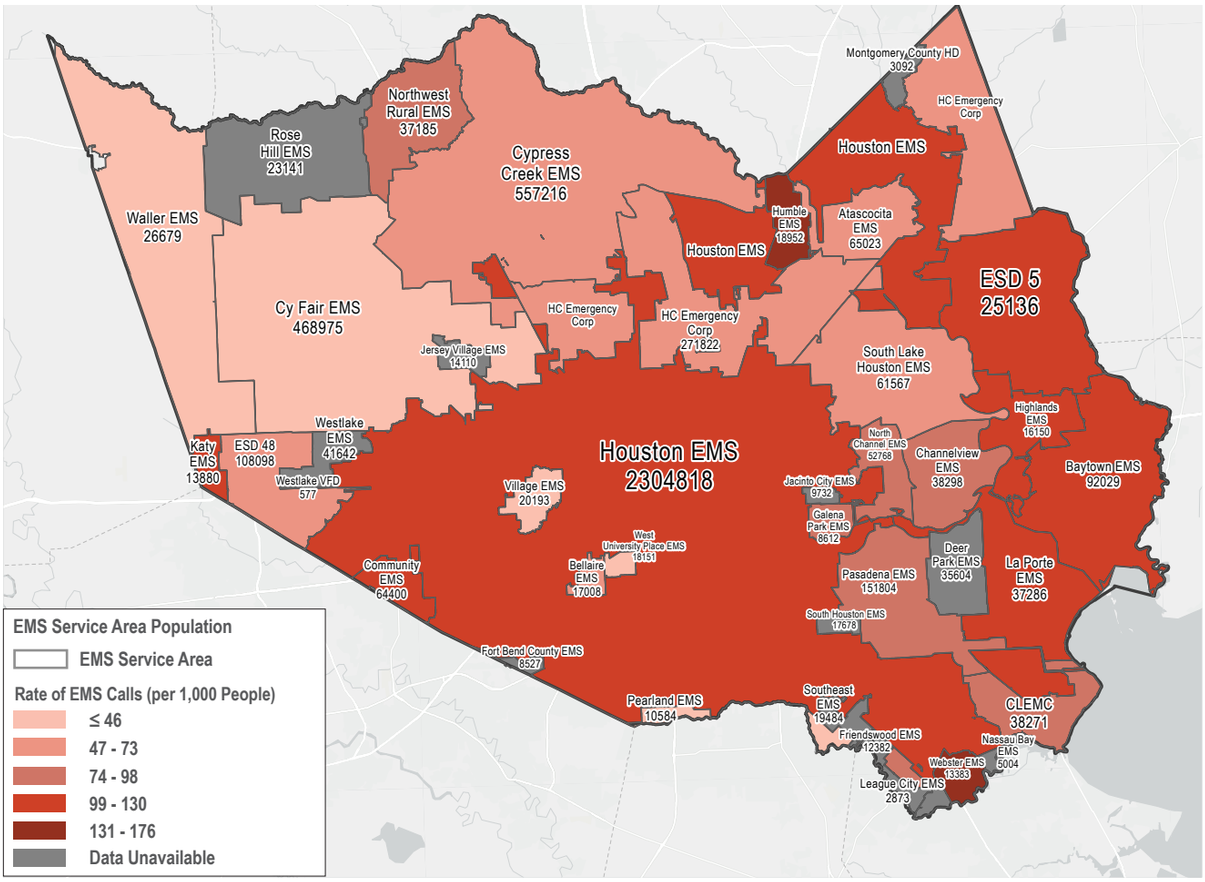


Figure 1.35 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.
Source: Esri Demographics, 2018; Office of Public Health Preparedness and Response, Harris County Public Health; Greater Harris County 9-1-1 Emergency Network, 2019.

Language and cultural barriers also pose a unique challenge to trust and communication between residents, providers, and health systems. Despite the fact that there are 145 languages spoken in Harris County and 25% speak languages other than English in their home, only about half (52%) of free/low-cost/sliding scale clinics offered services in both English and Spanish and only four clinics (4%) offered translation services for other languages (Table 1.8).[83] Taken together, despite the community's diversity, 44% of clinics did not offer services in any other language other than English. Since these clinics offer the primary and/or specialty care services that many under- and uninsured populations need, the lack of language services offered can pose a significant barrier to non-English speaking individuals.

Harris County can eliminate barriers in acceptability and accommodation of its residents by engaging in certain strategies such as focusing on customer service, developing more inviting and comfortable clinics, adding non-traditional evening and weekend hours, and respecting the diversity of languages in the county. There are existing ongoing efforts such as Harris Center's exploration of expanded hours and increased diversity of its workforce as mentioned in interviews with local stakeholders. Efforts like this must be sustained to ensure that residents receive readily available language translation and culturally appropriate services and programming.

Public Charge

Acceptability of the health system for undocumented populations was a frequent concern of HCPH partners in several key informant interviews with local government. This is explored in detail later in this study. **Many stakeholders indicated the current system has it backwards: unlimited emergency care is available, yet preventive and primary care are prohibitive.** In August 2019, this barrier was compounded by a proposed federal rule change for "public charge."[84] The rule change would broaden programs that the federal government considers in public charge to include previously excluded health, housing, and nutrition programs, such as Medicaid and the Supplemental Nutrition Assistance Program. Previous experience and recent research suggest that a rule change like this would likely cause large disenrollment in current health coverage or cause immigrant and refugee populations who may need assistance to deny assistance for fear of affecting their children or family's status.[85]

This rule change would strain not only on Harris County's large and often disproportionately affected immigrant and refugee population, but also the health system and clinical providers who must navigate new political barriers, whether real or perceived, to provide basic care for immigrant families. This may also even have an adverse effect on other non-immigrant populations who are accessing public services and may perceive that health services are somehow tied in with law enforcement and other similar entities. The decline in access for preventive services with immigrant and refugee populations that already face extreme and stressful challenges in assimilating to the US health system

in particular will likely lead to downstream and expensive costs to the taxpayer. This would exceed any potential gains from denying Medicaid or other forms of assistance.

To address these and related issues, Harris County would benefit by supporting broad community-wide efforts such as expanding and sustaining ongoing work for clinicians and clinics alike to enter into medical-legal partnerships that embed lawyers into health care settings with the goal of addressing legal issues affecting health. An example of such an integrated approach is the statewide Texas Medical Legal Partnership Coalition that aims to support the close to a dozen medical-legal partnerships within the state. Further discussion with legal partners such as at the Harris County Attorney's Office and other stakeholders would help further define this work locally.

> Physicians face a difficult challenge to provide sound health counsel.
>
> "For example, what will physicians advise the 50-year-old woman who has a Limited Stay Visa, with two children born in the United States, who have hypertension and type 2 diabetes? Should she forego her oral medications, a visit to the ophthalmologist to check for retinal disease, a mammogram, and cervical screening so that she can increase her chances of staying with her children? If she presents with a cough, should she be advised to go to the emergency department (because emergency services are exempt from public charge) and hope that emergency clinicians can also titrate her blood pressure medicine? How can physicians and other health care professionals help her balance concerns about her health and her family?"[86]

Affordability

Affordability of care for Harris County residents is best described by discussing two factors: 1) the rates of health insurance coverage across Harris County and 2) out-of-pocket costs and deductibles for those who have insurance. Texas is known as the uninsured capital of the United States and has an uninsured rate of 1.7 times the national average (Table 1.9).[87] From 2013-2017, 28% of Harris County adults aged 19-64 were uninsured.[88] In 2018, about 53% of Houston area residents had private insurance, 12% had Medicare, 6% had other public insurance, including Veterans Administration and Medicaid, and 27% were uninsured.[89]

With only 79% of residents insured, Harris County has substantially fewer insured residents compared to Los Angeles County and Cook County, the two largest counties in the United States, at 87% and 89% respectively (Figure 1.36). The uninsured rate within Harris County has a substantial and alarming imbalance between populations (Figure 1.37).

In Harris County, between 2013 and 2017, of those who were unable to see a doctor in the last month because of cost, 51.5% were employed, 12.8% were unemployed, and 35.7% were homemakers, students, retirees, or unable to work.[90] These disparities in coverage and access to care, are even more pronounced in minority and underserved populations, with the Hispanic population most likely to be uninsured (48%).[91] Furthermore, the rate of uninsured adults in Harris County varies greatly by geographic location, from 6% to 39%, as shown in Figure 1.38.[92]

Figure 1.36 Insured and Uninsured Adults (%)

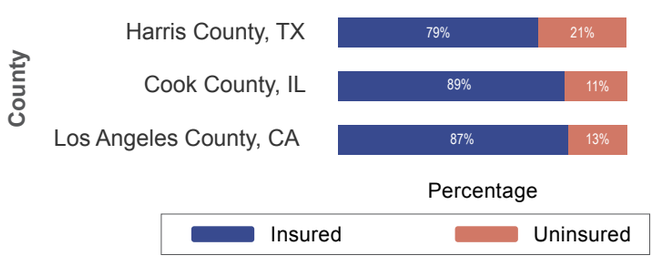


Figure 1.36 Percentage of Adults That Were Insured and Uninsured, Three Largest US Counties, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.







Figure 1.37 People Without Health Insurance (%)

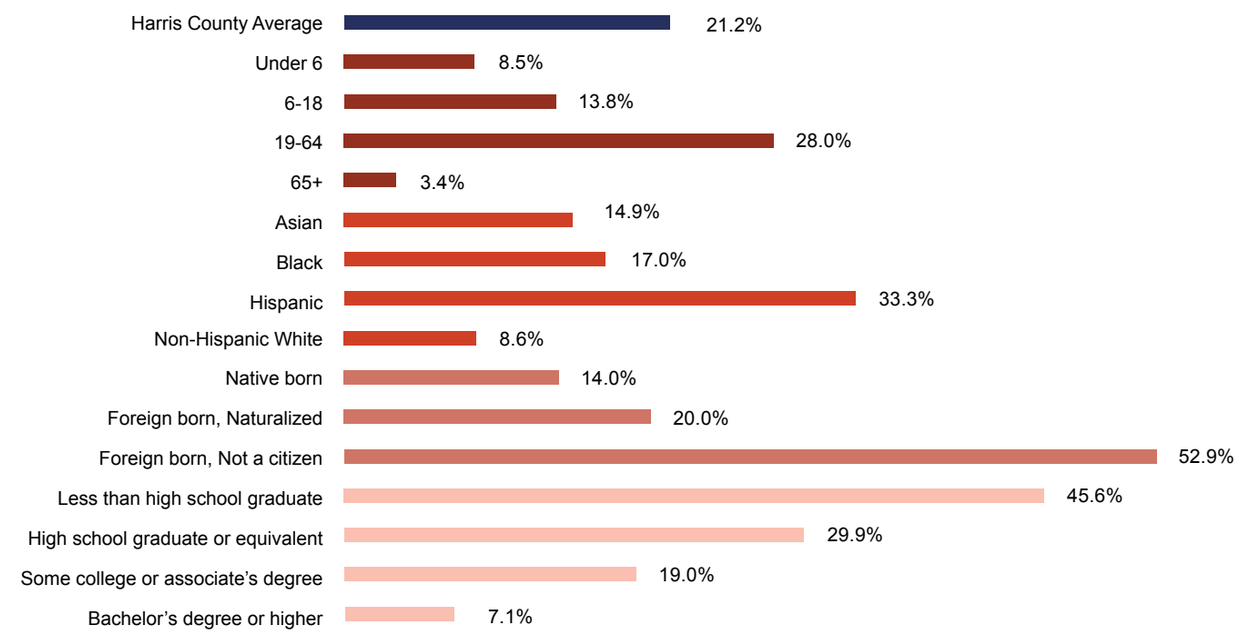
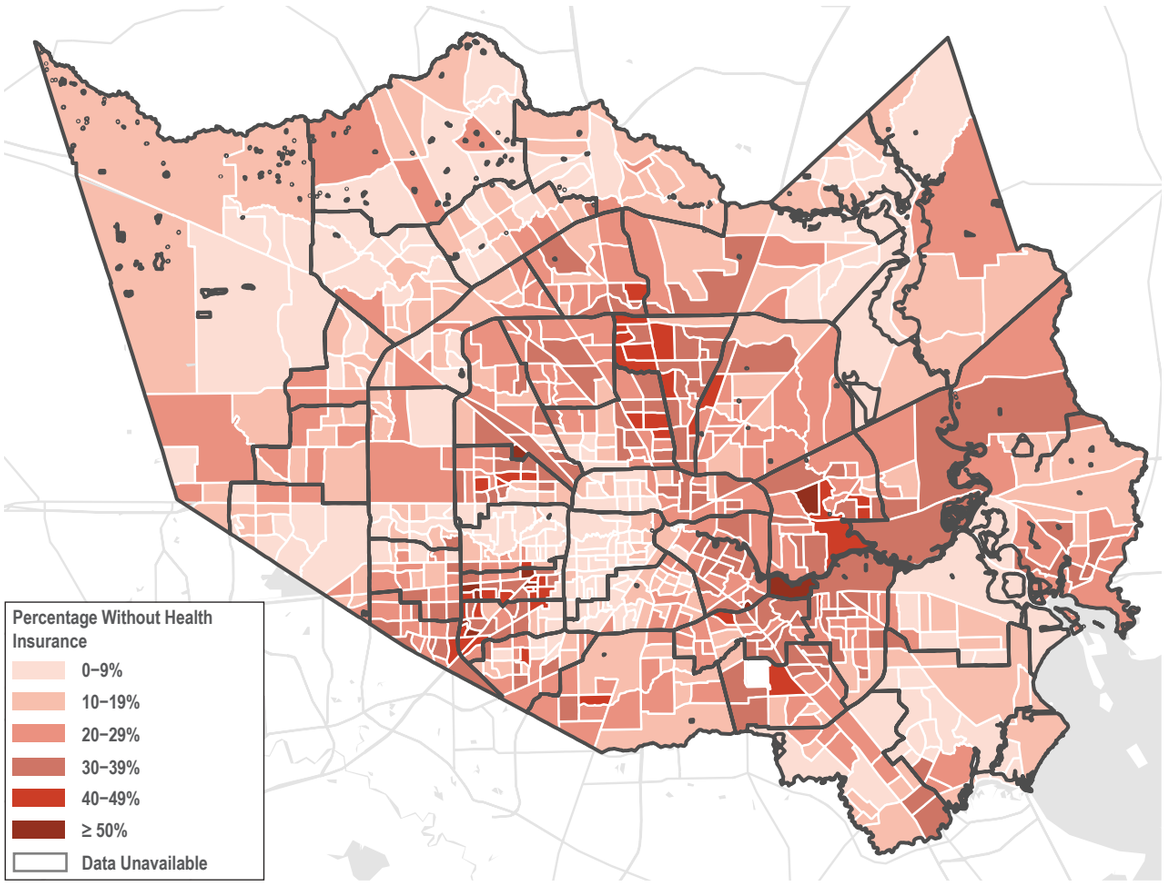


Figure 1.37 Percentage of People Without Health Insurance by Socio-Demographic Group, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Figure 1.38 People Without Health Insurance (%)



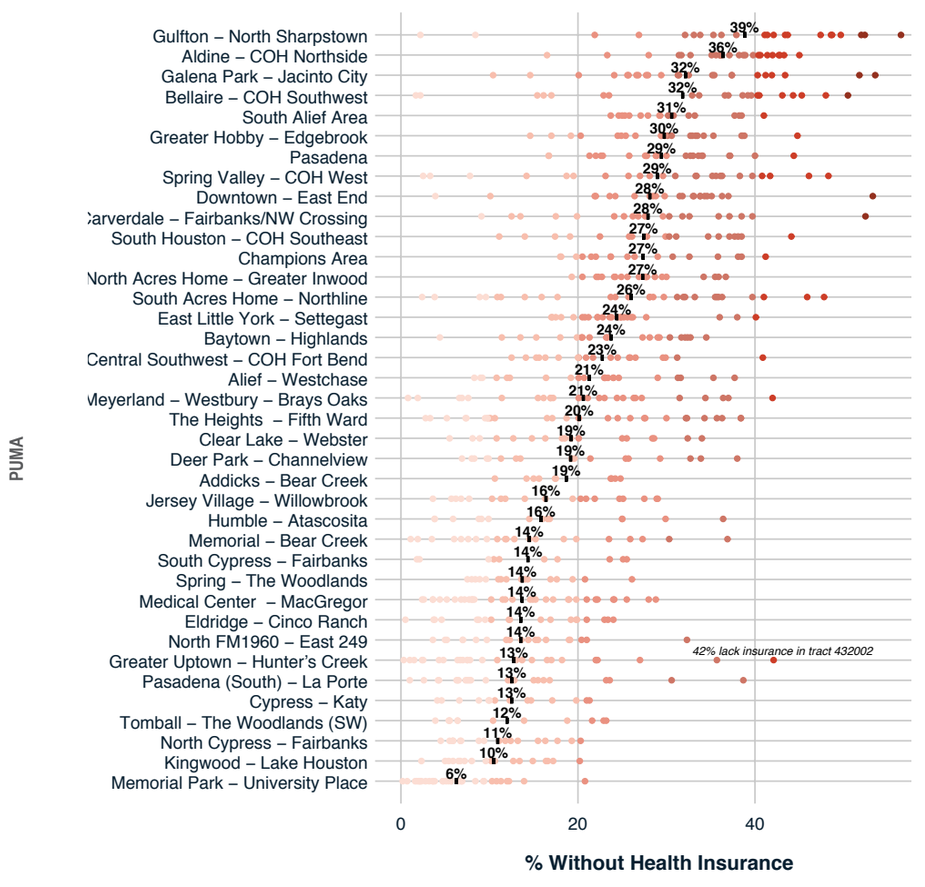


Figure 1.38 Percentage of People Without Health Insurance by Census Tract, Harris County, TX, 2017.
Note: Each dot represents a census tract within each neighborhood.
Source: American Community Survey, US Census Bureau, 2013-2017.

Uninsured

According to the Texas Medical Association, the nation's largest state medical society with more than 52,000 physicians and students, the uninsured are a diverse group of people that includes those who cannot afford private health insurance.[93] However, uninsured populations may also include those who can afford it but choose not to purchase it or simply cannot afford it nevertheless. It includes those who work in small businesses that do not offer insurance, recent immigrants, and/or those who are eligible for government sponsored programs like Medicaid and the Children's Health Insurance Program (CHIP) but are not enrolled.

Complex enrollment and renewal processes are known to pose barriers to Medicaid enrollment.[94] For example, in some circumstances, a person must take time off work to apply in person, provide paper documentation of income and other eligibility criteria, and wait weeks to months for an eligibility determination. Additionally, individuals must repeat these steps for renewal, which could occur as frequently as every six months. In 2003, Texas increased premiums, established a waiting period, and moved from a twelve-month to a six-month renewal period for children enrolled in the state's CHIP. Subsequently, there was a 30% decline in enrollment in the nine-month period following these changes.[95]

Young adults are the largest group of people uninsured in Harris County—only 65% of 19 to 25-year-olds indicate having some type of health coverage. In contrast, 97% of those 65+ years and older had health care coverage between 2013 and 2017.[96] Limiting accessibility of care to an older population is detrimental to the system as younger adults tend to be a healthier group who are generally lower utilizers of health care. Lowering the costs of care (e.g., lower copays and deductibles) combined with other strategies to improve access, may encourage a greater number of young people to seek coverage and offsetting costs of the older adult population which tends to be sicker and costlier to the system.

In Harris County, although the rate of privately insured and publicly insured residents has seen growth from 2013 to 2017, one in five residents remain uninsured (Figure 1.39). It is not accurate to assume that all employed Harris County residents are insured. In fact, only around 49% of private sector firms offer coverage.[97] In one study, uninsured Harris County residents indicated their top justifications for not being covered are because it was not affordable, they were ineligible because of their working status, or because they did not believe in health insurance.[98]

When the ACA was originally passed, it required states to provide Medicaid coverage for adults 18 to 65 years of age, with incomes up to 133% of the federal poverty level (FPL), regardless of age, family status, or health status.[99] However, the US Supreme Court subsequently ruled that the expansion of Medicaid was voluntary for states. While the majority of states decided to expand Medicaid, Texas has not.[100] In Texas, adults with incomes between 100% - 138% of the FPL, and who do not qualify based on disability, age, or other factors, fall into a gap as their incomes are too high to receive Medicaid, but their incomes are below the range the law set for savings on a Health Insurance Marketplace or "Exchange" plan.

"I haven't had health insurance until this past August with my new job. I didn't have insurance for 10 years, and I was too broke. I was living from paycheck to paycheck to pay my bills. I have insurance now, and it's a matter of fitting doctor's visits with my schedule."

—Lauren C., Harris County Resident

Figure 1.39 Adults by Types of Health Insurance (%)

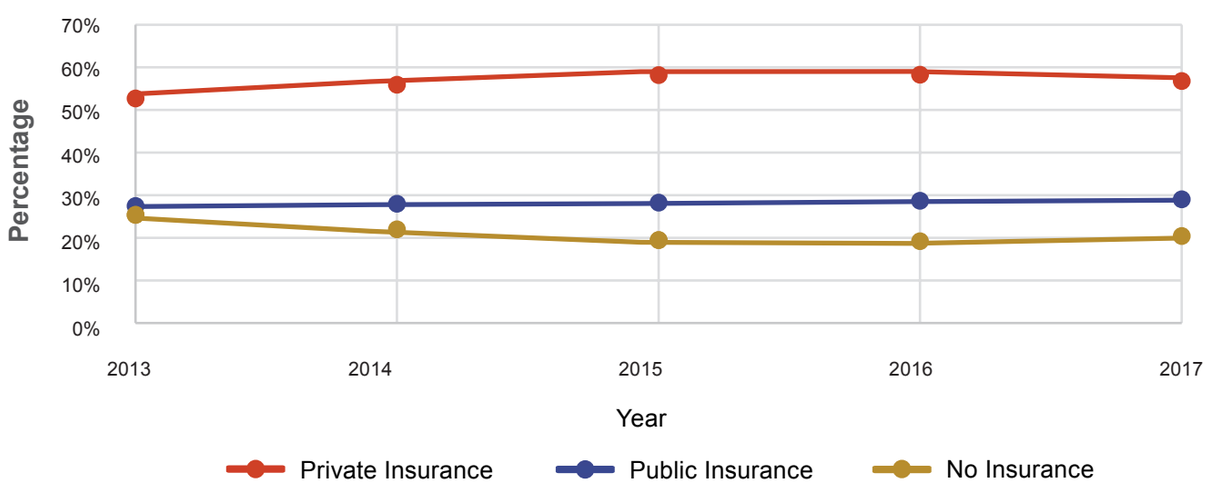


Figure 1.39 Percentage of Adults That Had Private Insurance, Public Insurance, or No Insurance, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Underinsured

Among those who have insurance, there is still a population that have issues with paying high deductibles or copays relative to their income. This group of people are considered "underinsured" because they cannot afford to pay out-of-pocket for these expenses. The underinsured rate in the United States increased between the years 2014 to 2018, with the greatest growth among people in employer-sponsored health plans.[101] According to the Commonwealth Fund's latest Biennial Health Insurance Survey, among adults nationwide who were insured all year, 29% were underinsured in 2018, up from 23% in 2014.[102] **Taken as a whole, Harris County has one of the nation's largest under- and uninsured populations.**

The reason health insurance is so important for one's ability to access health care services is that high health care costs due to self-pay, or under- or uninsured can lead residents to delay seeking care. Approximately 15% of Harris County residents reported delaying or not accessing at least three different kinds of care (e.g., filling prescriptions, seeing a doctor, or seeing a specialist) because of cost or lack of insurance. More specifically, Figure 1.40 shows the percentage of Harris County residents who delayed seeing a doctor, by PUMA. From this, we can see that nearly one-third of residents who live in Aldine-COH Northside had to delay seeing a doctor.[103]

"We have got to do a better job of coordinating our efforts to positively impact the health of our communities. This lack of coordination keeps us working in silos; thereby not being as effective as we could be. Our communities deserve so much more."

—Marcie Mir, CEO, El Centro de Corazon

Even residents with health insurance are vulnerable to high costs of health care, especially with the emerging trend of "surprise billing." Surprise billing occurs when a patient visits a provider, clinic, or hospital that is outside their network. Often the patient does not even realize they are out of network before being exposed to the higher costs of care. The most recent legislative session passed SB 1264 which aimed to eliminate surprise billing. However, there is growing concern that legal loopholes and limited implementation may allow for the practice to continue.[104]

In the Health Insurance Marketplace created by the ACA, recent changes to federal rules have eliminated funding for "cost sharing reductions" that lower deductibles and copayments for lower income families. Nationally, from 2013 to 2017, individual health insurance premiums increased by 105%, and many health insurers exited the Marketplace, reducing competition and consumer choice.[105] This has occurred in Harris County as well, resulting in premiums that are too high for moderate-income Harris County residents whose incomes are just above the limits for subsidies. Additionally, in response to the federal rule changes, insurers are aggressively marketing cheaper insurance plans that provide limited amounts of coverage.[106] One health system stakeholder of Harris County points to this trend as a need for accountability to the community's health by the corporate and business community who may prefer "unlimited access and a maximum discount." In other words, this stakeholder suggests that many businesses are focused on increasing access to diagnostics and treatment, but not prevention.

These and similar insights suggest that Harris County should engage the business community to redirect their purchasing power towards upstream and preventive solutions to health care and not just practice reactionary behavior to optimize access to more concierge-type health services for those who can afford it or the health care delivery system (more "downstream"). **In the long run, this movement "upstream" should make fiscal sense to community stakeholders, taxpayers, government, agencies, and the business community alike.** The business community would benefit from increased awareness of how investing into systems like housing, transportation, and other elements of the social determinants of health would impact the ultimate costs of health purchasing. Once understood, it is hopeful the business community would rally behind more upstream solutions.

Through Section 1332 of the ACA, states may apply for waivers to key requirements and explore innovative solutions to establishing and subsidizing health plans and lowering premiums.[107] In 2019, The Centers for Medicare and Medicaid Services (CMS) offered new guidance for states to seek waivers, and to date, 13 states have been approved for a 1332 Waiver. National momentum and evidence are growing for reducing barriers to affordability in states with approved waivers.[108] In 2015, the Texas Legislature authorized future exploration of the waiver and in 2017, the Texas Department of Insurance offered a preliminary analysis of implementation and barriers to submitting a waiver through Texas Health and Human Services Commission (HHSC). To date, no waiver has been submitted or approved.[109,110] As the federal government relaxes restrictions on 1332 waivers, Harris County should partner with health systems and health plan partners to study and offer recommendations to the state on reducing the financial barriers to accessing care and other opportunities to address social determinants of health.

Locally driven solutions can also address high costs to care across a system. Harris Health, for example, experiences a low payor mix when compared to other nonprofit clinics or FQHCs that service similar populations. In fact, 60% of their patients are uninsured.[111] Preventable hospitalization costs, especially in areas with high rates of uninsured residents, suggest that by addressing barriers to preventive care, Harris Health will experience high rates of return. By addressing high costs of care through expanded financial assistance, such as Harris Health's investment in a managed care organization like Community Health Choice, Harris County could yield susbtantial financial savings down the road.[112]

Figure 1.40 Adults Who Delayed Seeing Doctor (%)

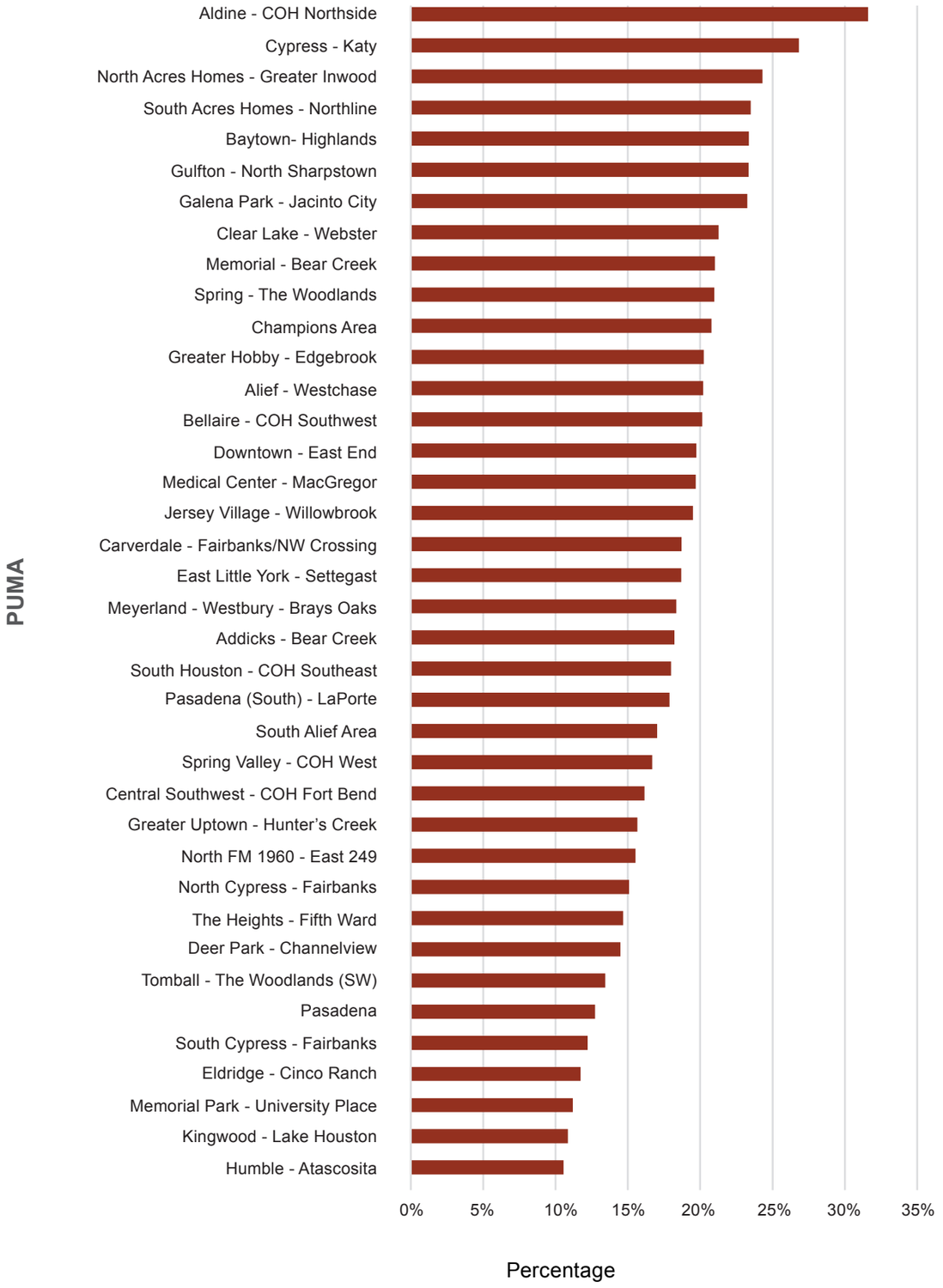


Figure 1.40 Percentage of Adults Who Delayed Seeing Doctor by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Conclusion

Harris County residents often face severe barriers to accessing timely care which includes the availability, acceptability, and affordability of services. Harris County's massive growth indicates a need for stronger health care infrastructure. By geospatially visualizing distance to health care services over varying factors of need, including social vulnerability, population growth, insurance coverage, and frequency of reported barriers to accessing care, policy makers and health systems can mobilize and intervene in specific communities with the highest need for greater and more equitable access to health care.



"Public health is the preferred path to leverage precious tax payer's dollars to improve the health of the people of Harris County through improved prevention and better outcomes."

—Dr. Eric Boerwinkle
Dean, UTHealth School of Public Health

4

The Business Case for Transforming Health

All of society feels the financial burden of poor health. The business case is clear, and as Benjamin Franklin once said, an ounce of prevention is worth a pound of cure. Health care costs to local government and the local health system is undeniably high. There is opportunity in the fact that many costs are preventable when good health is promoted before diseases becomes unmanageable and life-threatening. By identifying costs downstream in the treatment of poor health, opportunities emerge for targeted and community specific upstream intervention. The challenges to accessing good health, however, are complex, in part because incentives between multiple systems are unaligned. Many solutions to costs and inefficiencies in public health and health care offer some return on investment but do not address root causes of disease burden and structures that inhibit making the healthiest choice the easiest choice. Promotion of physical activity and healthy diet will certainly lower the costs of uncontrolled diabetes but is difficult to ensure in a community with crumbling sidewalks or fear of stray dogs and poor lighting. Amputation of feet because of uncontrolled diabetes can certainly be, in many cases, prevented by increased and ensured access to preventive services and medication as well as resources for self-management. Affordability to the taxpayer and to local government requires strategic insight into the costs and charges for poor health that accumulate downstream.

Introduction & Background

Disparities in health in the United States today represent $93 billion in excess medical care and $42 billion in untapped productivity.[113] As a whole, the nation stands to gain $135 billion per year by eliminating health disparities. Healthier residents have fewer sick days, are more productive in their jobs, and have lower medical costs. Using $50,000 per expected year of life in life expectancy estimates, the economic impact of shortened life spans is approximately $175 billion per year to the nation.[114] In some neighborhoods of Harris County, the average life expectancy is 10 years shorter than other neighborhoods within the county. It's unsubstantiated but reasonable to assume that the lowered life expectancy in these Harris County neighborhoods has a sizable financial cost (in addition to the emotional and community costs) on the local economy.

However, public health spending has declined for nearly two decades, with health care costs skyrocketing during the corresponding timeframe.[115] Federal, state, and local governments spend approximately $250 per capita on public health, with health care expenditures exceeding $10,000 per person. This equates to $0.25 on public health spending for every $10 on health care delivery spent nationwide.[116] A recent study found that a 10% increase in local public health expenditures corresponded with 7.5% fewer cases of infectious diseases and a decrease in 1.5% Years of Potential Life Lost – a measure of premature mortality (or death).[117] National health care expenditures are projected to grow at an average annual rate of about 5% from 2018-2027. They are projected in 2027 to reach close to 20% of the US GDP, amounting to well over six trillion dollars.[118] **A recent systematic review of 18 different public health programs found that investments in local public health had a median ROI of $4 saved for every $1 spent.**[119]

Evidence is growing that cuts to public health create a false economy. By saving pennies today, governments wind up with dollars of cost tomorrow. For example, investments into maternal and child health programs are associated with a significant reduction of low birthweight rates.[120] This overall system cost can be startling with government or social services having to bear the burden of a lifetime of costs that could have been prevented or mitigated by smart investment earlier in the cycle. The March of Dimes, for example, estimates the cost to Medicaid of preterm and/or low birthweight (LBW) babies is nearly 10 times the cost of a healthy, full-term baby.[121] LBW is defined as a newborn weighing less than 2,500 grams at the time of birth. Because Harris County's uninsured rate is 21%, many of the costs of care for babies born with LBW fall onto the safety net hospital system, Harris Health. Adding these and other costs annualized lead to significant costs to Harris Health, and ultimately, the taxpayer. Any public health prevention program that decreased the rate of LBW pregnancies would help drive down the costs and save the system (and therefore the taxpayer) substantial resources.

The general fund budget for HCPH has risen 23% over the last ten years compared to Harris County's total general fund budget, which has increased 106.9%. In 2019, HCPH had total funding amounting to approximately $100 million, of which 53% is grants. From fiscal year 2010-2020, HCPH's local funding grew just under $7 million, a 2% compound annual increase. During this same time, Harris Health's tax revenue has increased by $190 million. In fact, Harris Health's tax revenue is up just over 35%, in the aggregate, growing at a compound annual rate of 3.4%. Accounted for in a different way, for every $1 HCPH receives for its activities, Harris Health receives $25. Figures 1.41, 1.42, and 1.43 show the budgets of local health departments in Texas. Compared to HHD, HCPH has a lower total budget, funding per capita, and budget allocation.

Figure 1.41 Total Budgets

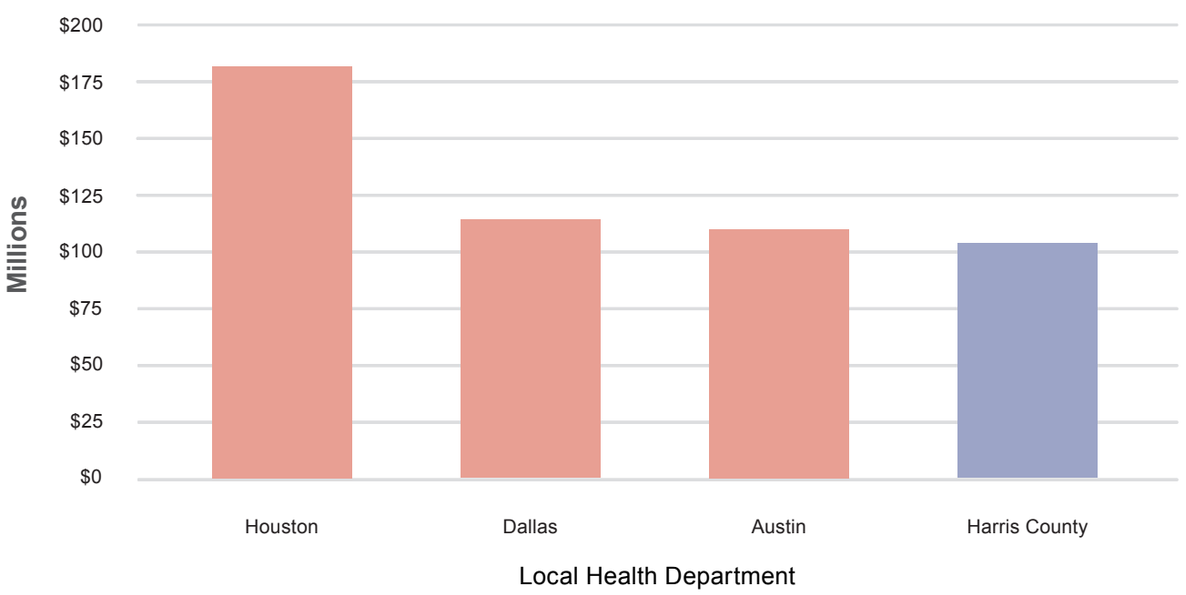


Figure 1.41 Total Budgets of Select Local Health Departments, Texas, 2019.
Source: County or City Websites.

Figure 1.42 General Fund per Capita

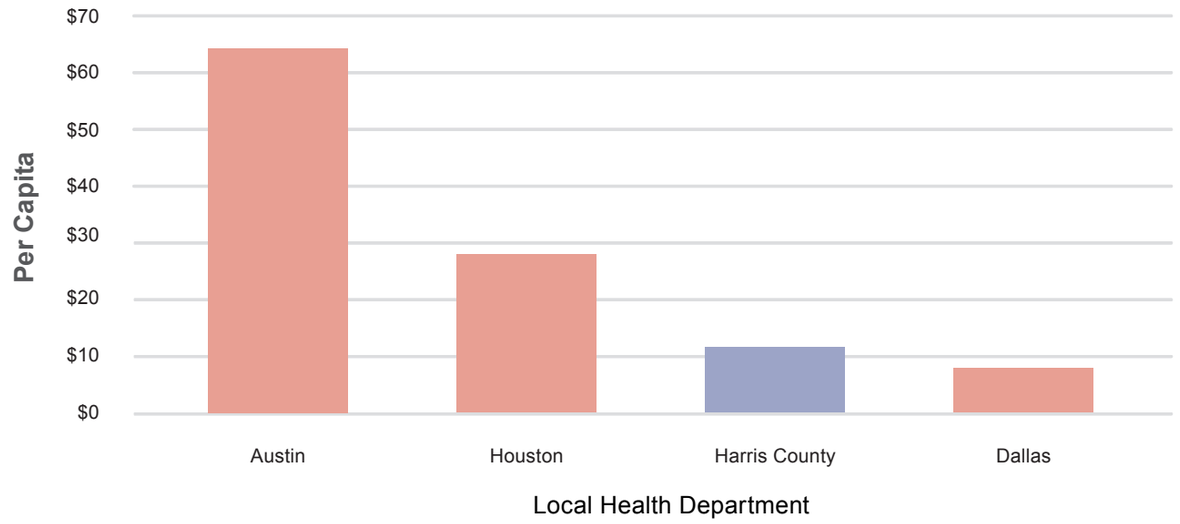


Figure 1.42 General Funding per Capita of Select Local Health Departments, Texas, 2019.
Source: County or City Websites.

Figure 1.43 General Fund Allocation (%)

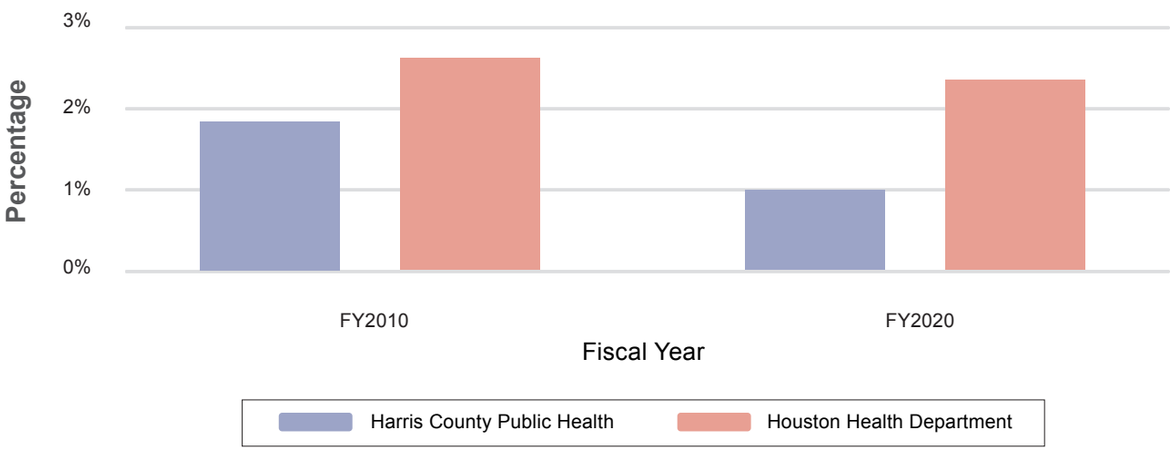
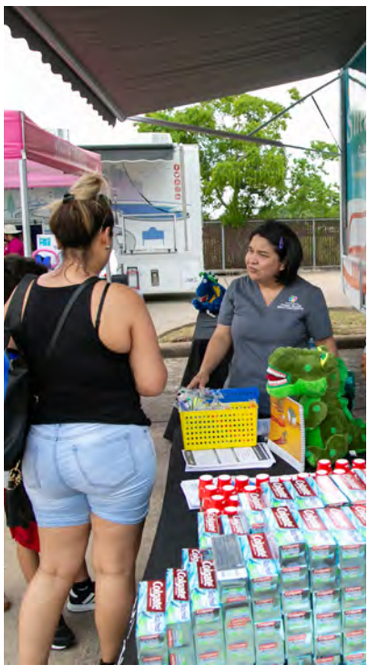


Figure 1.43 Percentage of General Fund Allocation of Select Local Health Departments within Harris County, Texas, 2019.
Source: Harris County Budget Management, City of Houston General Fund Summaries.

It is conceivable that Harris County's disproportionately lower spending on public health and prevention investment (in both health and social services) up front may be helping to push up Harris County's costs in health care delivery further downstream. This is not a unique phenomenon, as stated earlier. Truly, no community in the nation has solved the upstream-downstream funding equation fully. That said, some communities clearly have worked toward shifting the funding paradigm with more investment upstream. Recent increases to funding levels for public health by Harris County Commissioners Court earlier in 2019 are a promising first step to improving health care costs through prevention.

Downstream Costs with Upstream Opportunity



Often, the health care system is referred to as a "sick care" system, as it is focused on making the sick healthy again and not preventing the healthy from becoming sick in the first place.[122] Further, there is a false economy of prioritizing "sick care" over preventive efforts as public health and prevention are largely "invisible" in their work.[123]

While this applies nationally, it particularly hits home here in Harris County where TMC defines the health care landscape of the community. Nevertheless, despite this infrastructure, access to health services and distribution of poor health outcomes across Harris County presents clear inequity among residents. Even with stronger distribution of health care infrastructure and access, root causes of poor health are not fully addressed. Harris County must absorb costs for downstream and expensive hospital and emergency department (ED) utilization, both as a governmental entity specifically and as a community overall. This broadly presents an opportunity to align incentives for a healthier community.

The Upstream Parable

Irving Zola, in a widely cited article by John McKinlay, offered this metaphor for our current sickness-based health system and the need for upstream, preventive approaches for health: "Sometimes it feels like this. There I am standing by the shore of a swiftly flowing river and I hear the cry of a drowning man. So, I jump into the river, put my arms around him, pull him to shore, and apply artificial respiration. Just when he begins to breathe, there is another cry for help. So, I jump into the river, reach him, pull him to shore, apply artificial respiration, and then just as he begins to breathe, another cry for help. So back in the river again, reaching, pulling, applying, breathing, and then another yell. Again and again, without end, goes the sequence. You know, I am so busy jumping in, pulling them to shore, applying artificial respiration, that I have no time to see who the hell is upstream pushing them all in."[124]

Table 1.10 Preventable Adult Hospitalization Charges

Preventable Hospitalization Indicators	Total Associated Charges
Diabetes Long-Term Complications	$523,000,000
Chronic Obstructive Pulmonary Disease or Asthma	$426,000,000
Urinary Tract Infection	$426,000,000
Bacterial Pneumonia	$232,000,000
Angina without Procedure	$211,000,000
Hypertension	$204,000,000
Diabetes with Lower Extremity Amputation	$179,000,000
Diabetes Short-Term Complications	$121,000,000
Heart Failure	$114,000,000
Uncontrolled Diabetes	$101,000,000
Dehydration	$88,400,000

Table 1.10 Charges for Specific Preventable Adult Hospitalization Indicators, Harris County, TX, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Downstream Cost: Potentially Preventable Hospitalizations

The Agency for Healthcare Research and Quality (AHRQ) classifies potentially preventable hospitalizations as those that could have been prevented by effective primary care and outpatient services.[125] Utilizing an ED for non-urgent conditions, poorly managed chronic conditions, and preventable hospital admissions all indicate a deficiency in quality preventive care and sufficient public health investment. Uninsured residents tend to seek care in the ED, which is the most expensive setting of care.[126] Recent studies estimate 6% of ED admissions in the United States are for non-urgent issues that could be treated in a doctor's office or clinic and up to 75% of ED visits (which includes those not admitted) as well.[127,128,129] **The financial impact of uninsured Harris County residents places a significant burden on Harris County and its taxpayers.**

Preventable hospitalizations are admissions to a hospital for certain acute illnesses (e.g., urinary tract infections) or worsening chronic conditions (e.g., diabetes) that might not have required hospitalization had these conditions been managed successfully by primary care providers in outpatient settings. Although not all such hospitalizations can be avoided, admission rates in populations and communities can vary depending on access to primary care, care-seeking behaviors, and the quality of care available.[130,131]

Data was pulled from DSHS to determine the number of inpatient and outpatient cases and their total charges for preventable hospitalizations, as defined by AHRQ, for Harris County adult residents who went to a reporting facility within a Harris County zip code.[132] This data was mapped to visualize the percentage of adult hospitalizations that were preventable by resident zip code (Figures 1.44, 1.45). Table 1.10 shows the charges for specific preventable hospitalizations in Harris County. Total charges include a sum of accommodation charges, non-covered accommodation charges, ancillary charges, and non-covered ancillary charges.

In Harris County, 4% of all adult hospital visits were considered preventable. Chronic obstructive pulmonary disease (COPD) and asthma accounted for 18% of cases; various types of heart disease accounted for 21%; diabetes ranging from short-term to long-term complications accounted for 22%; and

urinary tract infections (UTI) accounted for 24%. Of the 189 reporting hospital sites, 25 hospitals saw 85% of preventable cases, with the top 10 hospitals accounting for roughly 50% of cases.

Totaling 110,000 cases, these preventable hospital visits charge 17% more on average than their non-preventable counterparts and yield a $1.9 billion outlay. Preventable hospitalizations charges represent 0.4% of the overall economy of Harris County (~$500 billion) as measured by gross domestic product (GDP).[133] Long-term complications of diabetes constitute the largest charge burden from avoidable hospitalizations in Harris County. With so many uninsured residents and high rates of ED utilization and preventable hospital admissions, Harris County is often faced with bearing the disproportionate costs of residents who could not access coverage and preventive services (Figures 1.46, 1.47). When designing targeted prevention efforts, it is critical to understand and define the goal to target the right community: reducing overall preventable hospitalizations (Figure 1.45), reducing preventable hospitalizations for the uninsured (Figure 1.46) or reducing high-cost preventable hospitalizations (Figure 1.47).

While Harris County should be applauded for its decades long commitment to the provision of care for those who could not afford it otherwise, the county must explore all avenues in supporting and improving the system. A transformation of investing both in health and social services would help to mitigate or avoid altogether the costlier expenditures of "sick care." In time, these kinds of investments could help bend the cost curve locally.

Downstream Cost: Urgent Care Facilities and Freestanding ERs

Nationwide, urgent care facilities have increased from 6,100 in 2013 to 8,774 in 2018.[134] Urgent care centers are available to provide minor emergency care during a disaster and allow for afterhours access for patients daily. On average, 35% of patients presenting to an urgent care do not have an affiliation with a primary care physician or medical home and urgent care is utilized for access to primary care. In the United States, there has been a 155% growth in freestanding emergency rooms, independent or hospital based, from 222 in 2008 to 566 in 2016.[135]

Texans use hospital-based EDs and urgent care centers much more than freestanding EDs, but freestanding ED utilization increased 236% between 2012 and 2015. The average price per visit was lower for freestanding EDs versus hospital-based EDs in 2012 ($1,431 versus $1,842), but prices in 2015 were comparable ($2,199 versus $2,259). This suggests that innovative clinical solutions alone will not drive down the cost of care. Prices for urgent care centers were only $164 and $168 in 2012 and 2015, respectively. Out-of-pocket liability for consumers for all these facilities increased slightly from 2012 to 2015. There was 75% overlap in the 20 most common diagnoses at freestanding EDs versus urgent care centers and 60% overlap for hospital-based EDs and urgent care centers. However, prices for patients with the same diagnosis were on average almost 10 times higher at freestanding and hospital-based EDs relative to urgent care centers.[136]

Figure 1.44 All Preventable Adult Hospitalizations (%)

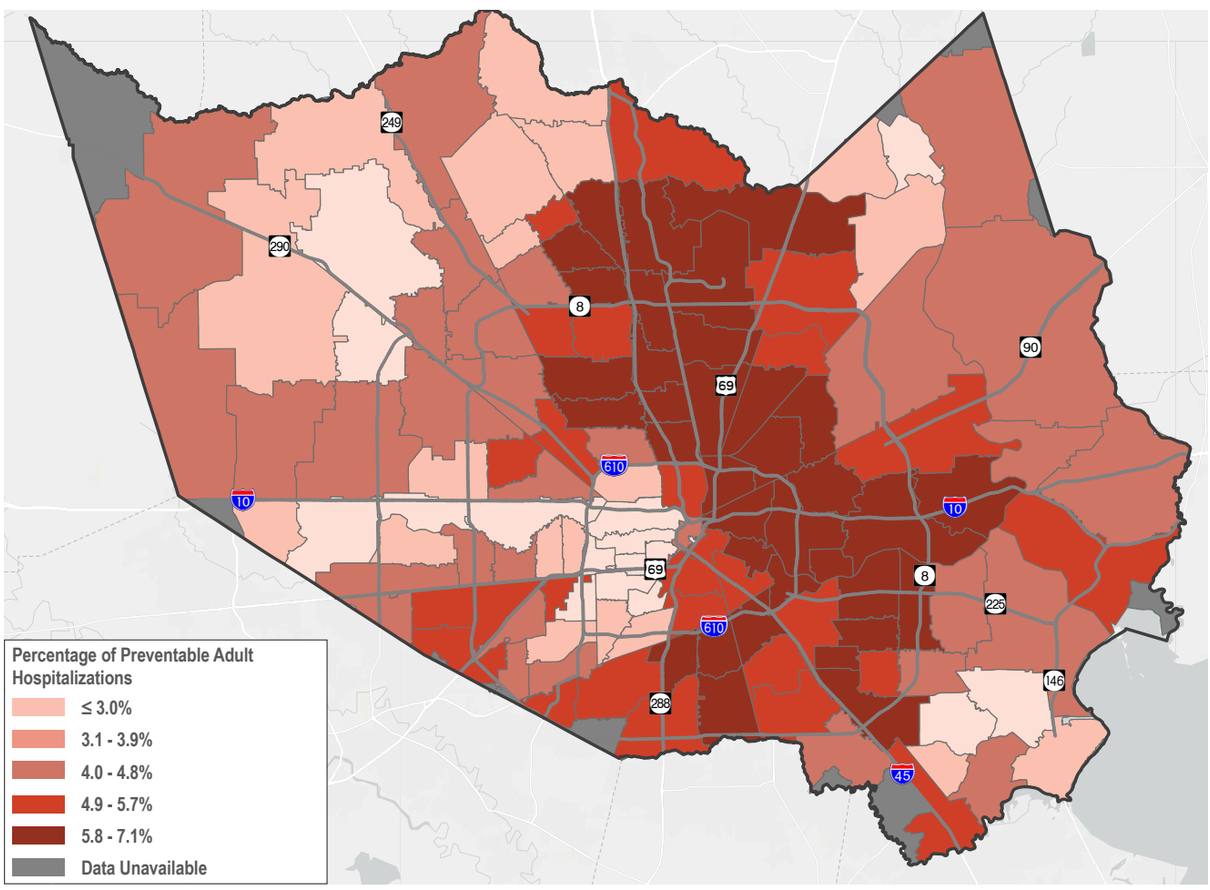


Figure 1.44 Percentage of All Preventable Adult Hospitalizations by Zip Code, Harris County, TX, 2017.
Note: Methodology to identify preventable hospitalizations was developed by the Agency for Healthcare Research and Quality (AHRQ).
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Figure 1.45 All Preventable Adult Hospitalization Charges

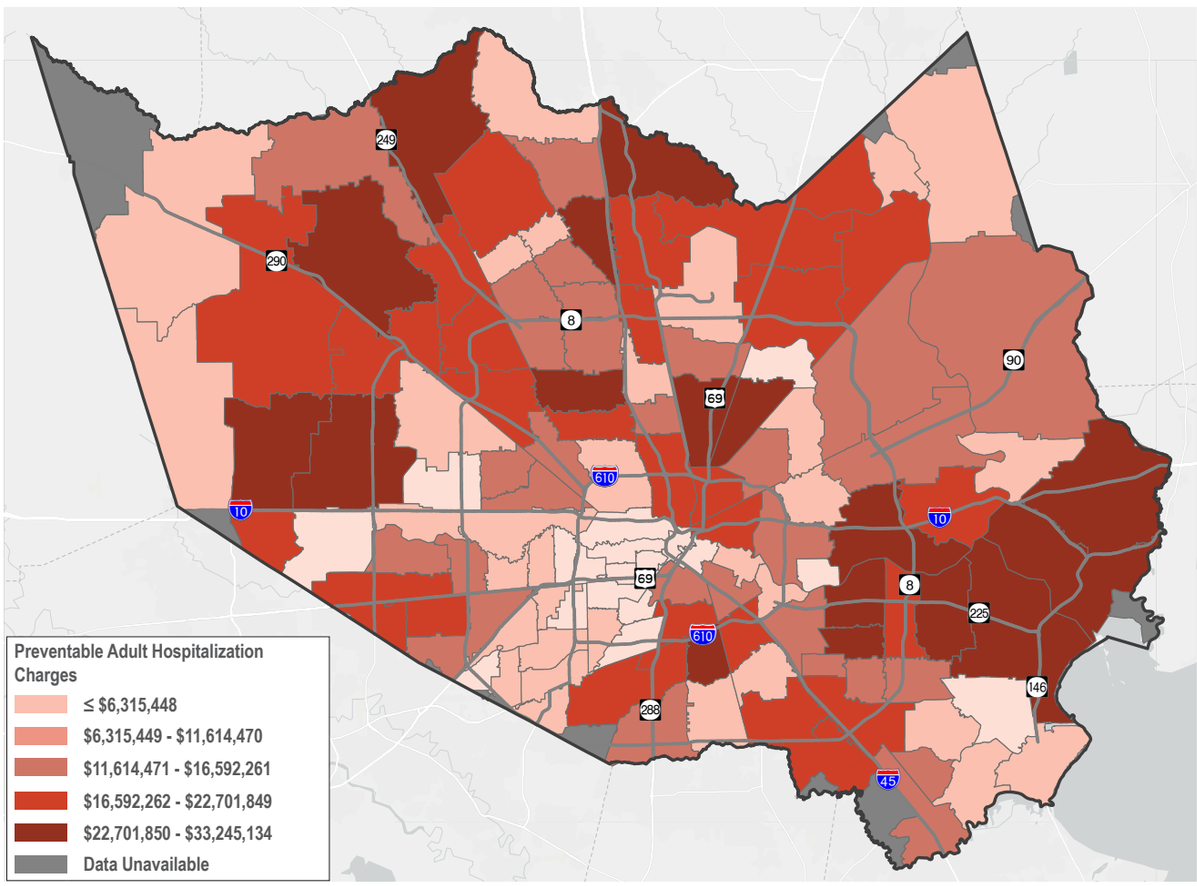


Figure 1.45 Total Preventable Adult Hospitalization Charges by Zip Code, Harris County, 2017.
Note: Methodology to identify preventable hospitalizations was developed by the Agency for Healthcare Research and Quality (AHRQ).
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Figure 1.46 Preventable, Uncompensated Adult Hospitalizations (%)

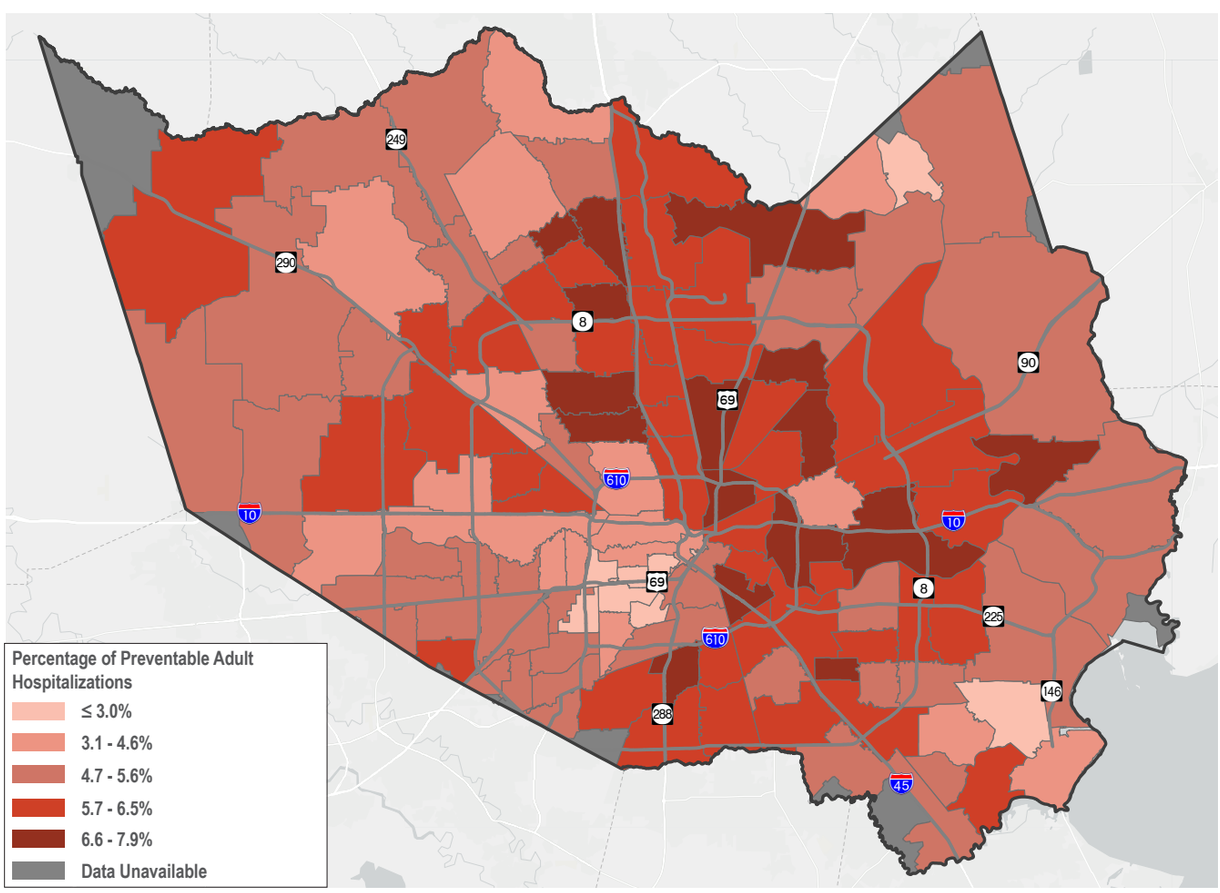


Figure 1.46 Percentage of Preventable Adult Hospitalizations Whose Primary Payment Was "Charity, Indigent or Unknown" by Zip Code, Harris County, TX, 2017.
Note: Methodology to identify preventable hospitalizations was developed by the Agency for Healthcare Research and Quality (AHRQ).
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Figure 1.47 Preventable, Uncompensated Adult Hospitalization Charges

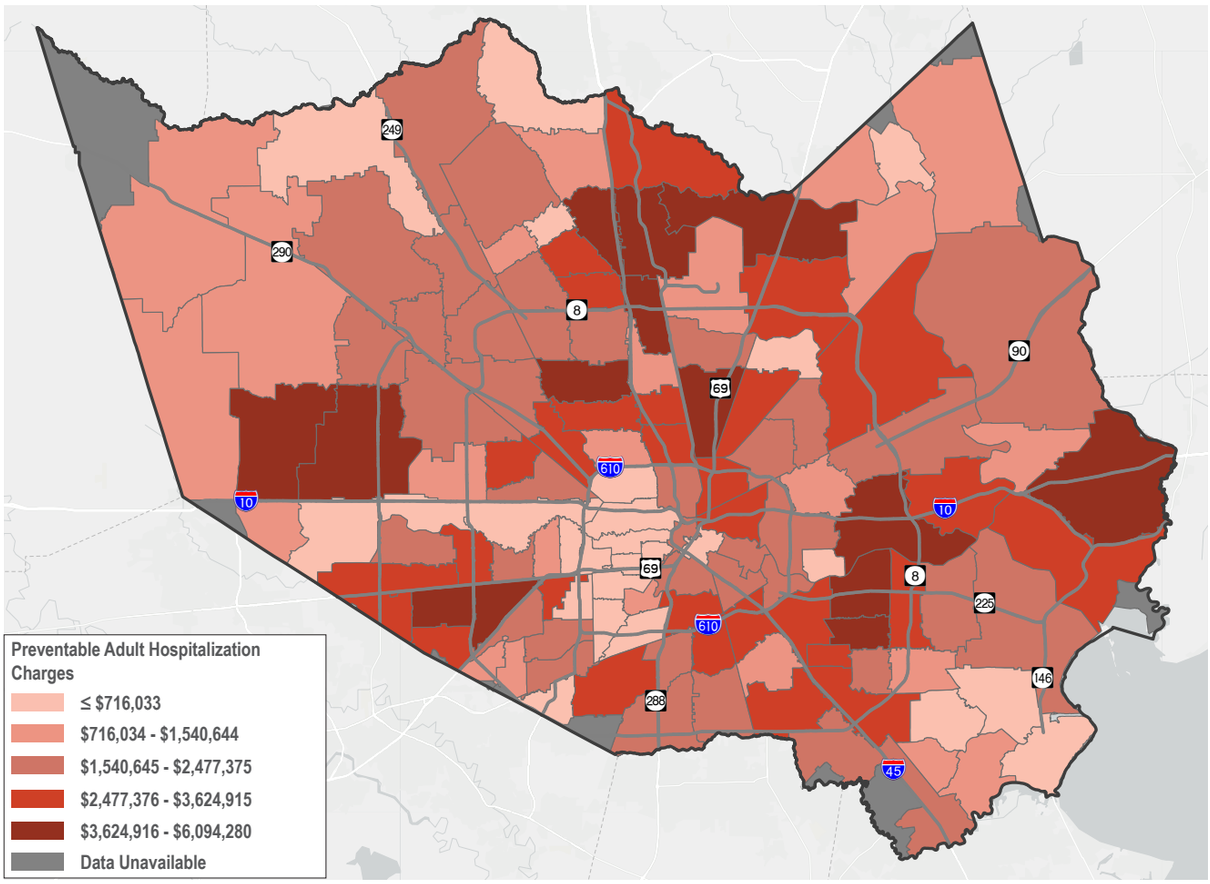


Figure 1.47 Preventable Adult Hospitalization Charges Whose Primary Payment Was "Charity, Indigent or Unknown" by Zip Code, Harris County, TX, 2017.
Note: Methodology to identify preventable hospitalizations was developed by the Agency for Healthcare Research and Quality (AHRQ).
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Figure 1.48 Majority Payor Type for ED Visits

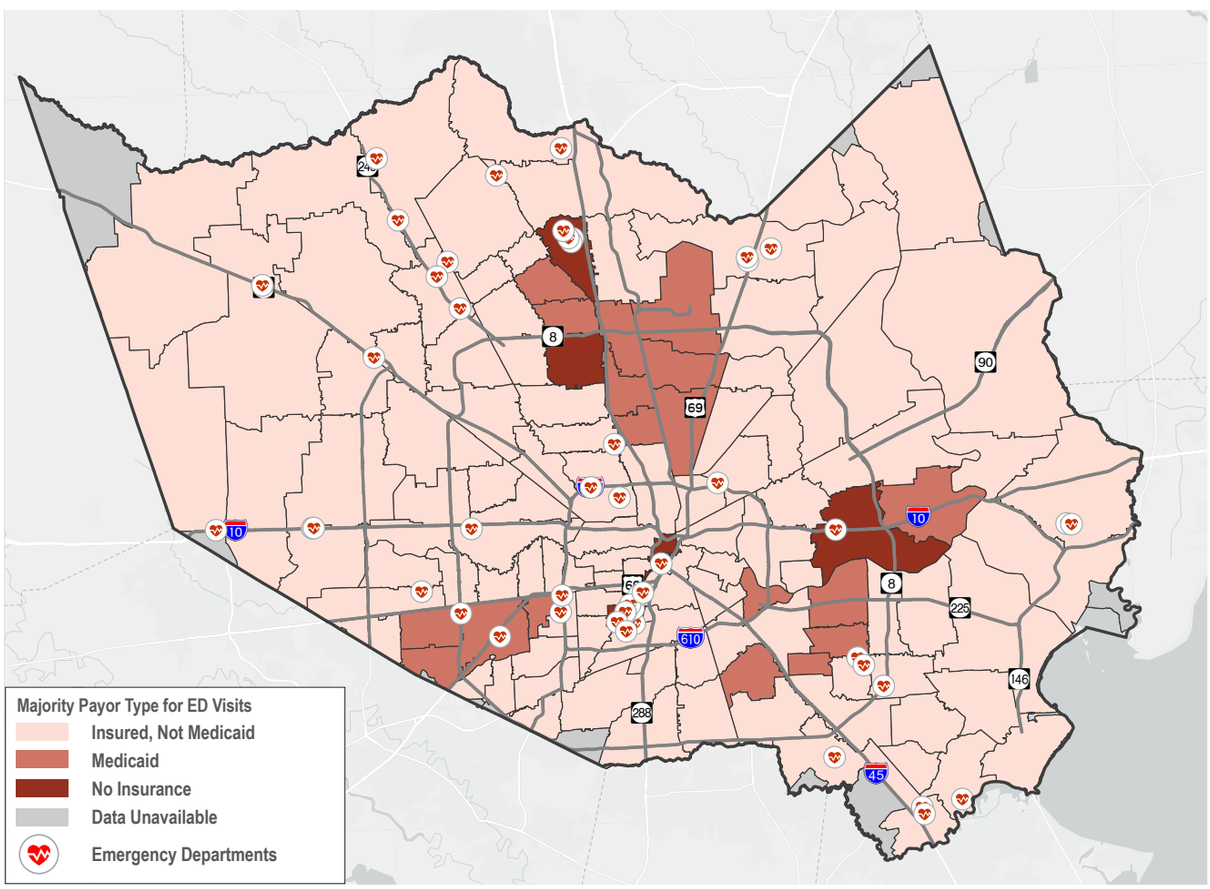


Figure 1.48 Majority Payor Type for Emergency Department Visits by Zip Code, Harris County, TX, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Case Example:

Minnesota: Hennepin Health Accountable Care Organization (ACO) is a partnership of their county health department, community hospital, and FQHC that accepts full risk payment for all medical care, public health, and social service needs for Medicaid enrollees.[137] They have a fully integrated EHR exchange and have invested heavily in care coordinators and community health workers. Savings from avoided medical care are reinvested in public health initiatives, such as nutrition and food environments and physical activity programs. Between 2012 and 2013, Hennepin Health ACO improved access to primary care and reduced acute care, with ED visits decreasing by over 9% and outpatient visits increasing by 3.3%, They state that it "takes a community wide approach to care for the most vulnerable residents."

Case Example:

In 2014, the City of Houston and the Houston Fire Department (HFD) initiated a 1115 Waiver project which sought to improve community care by directing patients to the proper treatment location and not simply transporting all patients that call EMS to local emergency departments. The Emergency Telehealth and Navigation (ETHAN) 1115 Waiver project is a community-wide collaboration led by HFD that uses mobile technologies, community-based paramedicine, and local and regional partnerships with other agencies and organizations, to triage and connect low-acuity 9-1-1 callers with primary care resources in the community. The on-scene paramedic provider contacts the medical director on call via telemetry for guidance of alternative transport locations. This innovative project attempts to reduce unnecessary ED transports which compound Harris County's problem of ED overcrowding. The HFD has applied to participate in the ET3 model under the CMS to be able to continue the ETHAN program. Private funding grants will be used to support the ETHAN program until the ET3 application is approved by the CMS.

Tables 1.11 and 1.12, indicate preferences between population groups for non-emergency care and indicate need for infrastructure. Under current CMS guidelines, EMS agencies cannot be compensated for transporting low acuity patients to an urgent care center. The public often has a hard time differentiating between urgent care centers and free-standing emergency rooms that function the same as most hospital-based emergency rooms. Urgent care centers sometimes have nurse practitioners or physician assistants instead of physicians, but freestanding emergency rooms are required to have a physician on site. Future studies should look at timely delivery and appropriate access to care, both during disasters and on a daily basis, for hospital-based EDs, freestanding EDs, FQHCs, primary care physicians and urgent cares.

Downstream Cost: Emergency Medical Services

It is important to note that EMS agencies in Texas are not given the status of "essential services," that is a service that the government is required, by law, to provide to its residents.[138] This has consequences as local tax subsidies have been used to offset costs for all EMS system components. Federal health care policy currently reimburses ambulance service as a transportation benefit. In other words, EMS must transport the patient to an emergency department to receive compensation from federal payors and most commercial insurance companies. Pay-to-transport encourages transport of low acuity patients to emergency departments that may already be overcrowded. Due to this counterproductive system, the CMS has initiated a new five-year trial program called Emergency Triage, Treat, and Transport (ET3). Under the ET3 model, CMS will pay participating ambulance suppliers and providers to: 1) transport an individual to a hospital ED or other destination covered under the regulations, 2) transport to an alternative destination (such as a primary care doctor's office or an urgent care clinic), or 3) provide treatment in place with a qualified health care practitioner, either on the scene or connected using telehealth. The model allows beneficiaries to access the most appropriate emergency services at the right time and place. The model also encourages local governments, their designees, or other entities that operate or have authority over one or more 9-1-1 dispatches to promote a medical triage line for low-acuity 9-1-1 calls.

Table 1.11 National Preference for Non-Emergency Care (Age)

Age	Primary Care	Emergency Department	Urgency Care	Walk-in Clinic at a Pharmacy or Retail Center
18-34	43%	25%	21%	7%
35-44	54%	21%	19%	3%
45-54	64%	19%	8%	5%
55-64	62%	16%	13%	7%
65+	59%	22%	9%	4%
Total Population	55%	21%	15%	5%

Table 1.11 National Preference for Non-Emergency Care by Age, National Sample, 2015.
Source: FAIR Health Survey, FAIR Health, 2015.

The ET3 model aims to improve quality and lower costs by reducing avoidable transports to the ED and unnecessary hospitalizations following those transports. CMS took applications for participants in the ET3 trial program until October 2019 and agencies approved for participation will be expected to begin implementation at the beginning of 2020. As it stands now, the national percent of transports by payor type are the following: Medicaid 14%, Private pay 14%, Medicare 44%, Commercial Insurance 21%, and other 7%.[139] Figure 1.48 shows the majority payor type for ED visits in 2017. There are three clustered areas in Harris County where the majority payor type was Medicaid or Uninsured. These areas may be ripe for piloting programs designed to reduce the cost of preventable hospitalizations, or programs designed to decrease the uninsured population.

Table 1.12 National Preference for Non-Emergency Care (Income)

Household Income	Primary Care	Emergency Department	Urgency Care	Walk-in Clinic at a Pharmacy or Retail Center
Less than $35K	44%	32%	16%	5%
$35 -$49.9K	61%	21%	11%	6%
$50- $74.9K	62%	15%	13%	6%
$75- $99.9K	76%	8%	11%	5%
$100K +	70%	5%	18%	3%
Total Population	55%	21%	15%	5%

Table 1.12 National Preference for Non-Emergency Care by Household Income, National Sample, 2015.
Source: FAIR Health Survey, FAIR Health, 2015.

Figure 1.49 ESRD Facilities and ED Visits

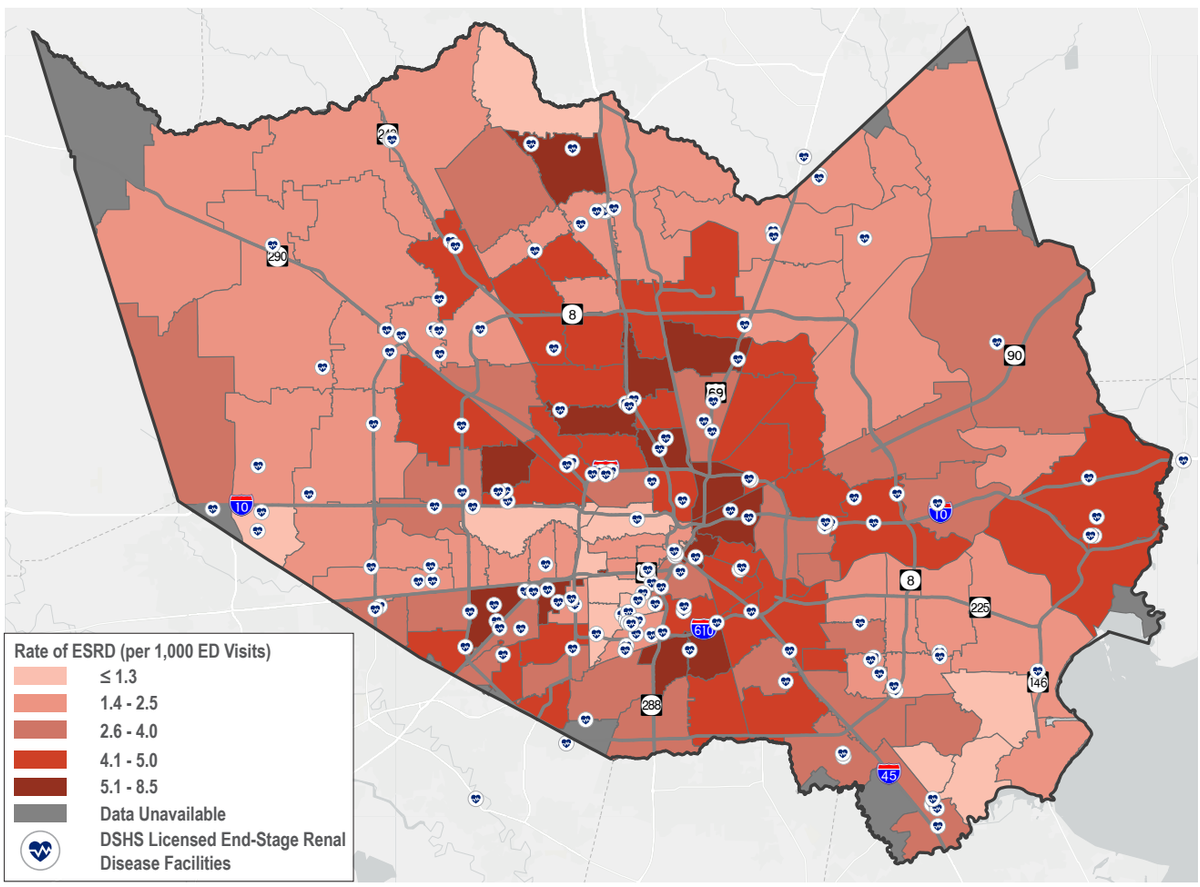


Figure 1.49 End-Stage Renal Disease Facilities and Emergency Department Visits Due to End-Stage Renal Disease per 1,000 Visits by Zip Code, 2017.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019; Center for Health Statistics, Texas Department of State Health Services, 2017.

ROI in Action: Dialysis

According to DSHS, in mid-2019 there were 152 licensed dialysis centers in Harris County. From 1985 to 2009, the total number of patients with end stage renal disease (ESRD) needing dialysis increased six-fold in Texas. According to CMS in 2017, more than 8,700 patients within the greater Harris County area (including Beaumont and Port Arthur) were receiving dialysis treatments. Further, this estimate of dialysis patients does not include undocumented immigrants who are unable to access regular dialysis services outside of the emergency department. The only reliable option available to undocumented immigrants is emergency dialysis services which cost nearly $285,000 annually per person. This is four times as much as regularly scheduled, three times per week, dialysis sessions estimated at $77,000 annually.[140]

The risk of early death for patients who receive emergency-only dialysis is greater than 14-fold higher compared to those who receive standard dialysis. Patients usually receive dialysis through a center three times weekly. Patients who don't receive dialysis three times weekly due to lack of insurance or patient compliance rely on dialysis services at local EDs to prevent worsening conditions that could be fatal. Harris Health has already innovated in providing care to this population, further investment into diverting ED visits for dialysis to something less costly should be explored.[141] This presents a potential opportunity for Harris County not only to saves lives but also saves taxpayer money.

During disasters, such as hurricanes, dialysis patients are often unable to receive treatment at their regular facilities due to damage to infrastructure, lack of transportation, power outages, and flooding. Because of this, the remaining medical infrastructure capable of providing dialysis, such as hospitals and unaffected dialysis centers, receive a high volume of patients needing dialysis post disasters. DaVita dialysis centers, for example, reported dialyzing more than 190 new patients in the three days following Hurricane Harvey because patients were unable to access their typical centers where they dialyze.[142] Houston Methodist Sugarland Hospital in neighboring Fort Bend County reported that at its peak, over 50 patients were in the hospital's emergency department needing dialysis post-Harvey.[143] Building upon the current network of dialysis options may assist in planning and preparedness for this disproportionately affected population in future emergencies (Figure 1.49).

ROI in Action: Tobacco Usage and Costs

Tobacco use is the number one preventable cause of premature death and disability in Texas. Every year, an estimated 24,100 Texans die from a smoking-related illness. In Harris County, roughly 16% of residents are smokers, just under the national estimate of 17%.[144,145] Smoking-related illness in the United States costs more than $300 billion each year, costing nearly $170 billion in direct medical care costs for adults, and more than $156 billion in lost productivity. Moreover, these estimates do not include the additional $6 billion in lost productivity due to secondhand smoke exposure. Smoking-related illness and lost productivity due to smoking equate to approximately 2% of the US GDP, and about 10% of US health care spending.

HCPH's Tobacco Prevention/Cessation Program serves over 350 participants per year through educational sessions on tobacco prevention and cessation for children and adolescents. Participants are involved in a series of four 60-minute discussion group sessions over a period of one month, typically held at inpatient and outpatient rehabilitation centers. The focus of this program is to offer tobacco cessation support and self-help techniques in order to provide participants the tools to make at least one quit attempt by the end of the four-week program. Participants are referred to the Texas Tobacco Quitline where they have the flexibility and convenience of having a trained counselor contact them to help form an effective quit plan.

The program also aims to provide tobacco prevention education to the youth through the "CATCH My Breath Program." It targets middle and high school-aged students who are exposed to tobacco products from an early age and is held at various schools in Harris County. The curriculum offers interactive activities and discussion sessions that provide students with knowledge on the risks of smoking and methods of saying "No" to tobacco products. HCPH's Tobacco Program had 365 participants in its most recent fiscal year. HCPH was successful in helping 18 participants quit smoking, as defined by the protocol – yielding a quit rate of nearly 5%.[146]

Each person who quit is estimated to have saved the health system $19,212. The total savings estimated for all 18 participants that quit smoking would be then $345,816. Costs for personnel to run this program are calculated to be $146,852. **This yields a cost benefit ratio of approximately 2.3 times.** Savings are derived from out-of-pocket costs; financial opportunity costs; health care costs; income loss; and other costs per smoker. It should be pointed out that it's difficult to measure ROI precisely and fiscal savings at a local level since many of the calculated and estimated variables are derived at a national level.[147] This also lays out the rationale for increased investment in both fiscal analysis and evaluation of local prevention-type programs. And it assures that community-based indicators and metrics are developed, validated, and utilized on an ongoing basis for Harris County's work in the future.

Using this example, it's easy to see the potential savings generated through increased investment in public health. Harris County has 3.3 million adults, of which approximately 16% or 500,000 are smokers. If the CATCH My Breath Program could somehow enroll all smokers and continue to achieve a 5% quit rate, then the program would **save the health system approximately $500 million.**

CATCH My Breath also works to lower the occurrence of teenage vaping. This program targets students 10 to 18 years old who are exposed to vaping at an early age. According to CDC, there was a 900% rise in e-cigarette use by youth from 2011-2015. Currently, the JUUL Device is the dominant e-cigarette, controlling 72% of the market. It's the product of choice among the youth and young adults. The curriculum offers four interactive and engaging lessons, 30-40 minutes each, in which students participate in activities and discussion sessions that challenge what they know about these products.

Upstream Opportunity

Fragmented Distribution of Resources and Investment into the Wrong Pocket

The true cost of care will never be found on a single line item of a county or other government budget and is thus difficult to calculate the true ROI and the impact of such programming (especially at a local level). Financing for health services and public health rely on a unique web of sources from local, state, federal, and private dollars each with unique constrictions and guidance (Figure 1.50). Coordination of resources for optimal health is exponentially complicated by competing priorities between and among these funding authorities and streams. The Commonwealth Fund Commission describes the health care delivery system as a "cottage industry" characterized by fragmentation at the national, state, community, and practice levels.[148]

There is a near universal understanding that financial resources should be balanced towards prevention. It is unreasonable to expect that federal and state financial health policy will shift radically enough to address the desire of Harris County stakeholders. However, reforms could be made by local government that can lower the costs and burden to taxpayers. **Harris County could serve as a model to the state and nation by preventing disease through refocusing of county funding streams in non-traditional ways on projects that ultimately impact health.**

The business model for local, state, and federal government is clear: Medical and productivity costs are borne not only out of the individual's pocket, but also by a community of taxpayers that support a safety net health system heavily reliant on a tangled web of private and public funding. Improving the business model, and therefore saving taxpayers, will require taking steps to decrease medical and productivity costs through upstream interventions.

> The value proposition of investing in health is not a new one. It has been called out globally, nationally, and certainly locally. The former CDC Director, Dr. Julie Gerberding, struck a similar theme in 2008. "There is no more valuable infrastructure than health, even more than roads and bridges. We have to appeal to people's emotions, so they don't lose sight of that at a time when the focus is on the economy."[149,150]

In today's health care payment system, delivery reform through national policy like the ACA has been narrowly tailored to reframe existing structures like fee-for-service but have lacked comprehensive reform towards long-term population health outcomes. "Existing fee-for-service payment has fostered our unequal health system, [but] new payment models could themselves inadvertently create additional incentives for providers to avoid patients with more complex needs or reduce health care utilization among populations whose main challenge is the underutilization of appropriate care."[151] Traditional payment reform efforts have often done wonders in the streamlining of health services but have not yet been able to prioritize the root causes of health inequities or incentivize the engagement of partners to screen for and ultimately address these issues.

Figure 1.50 Current Fragmented Safety Net System

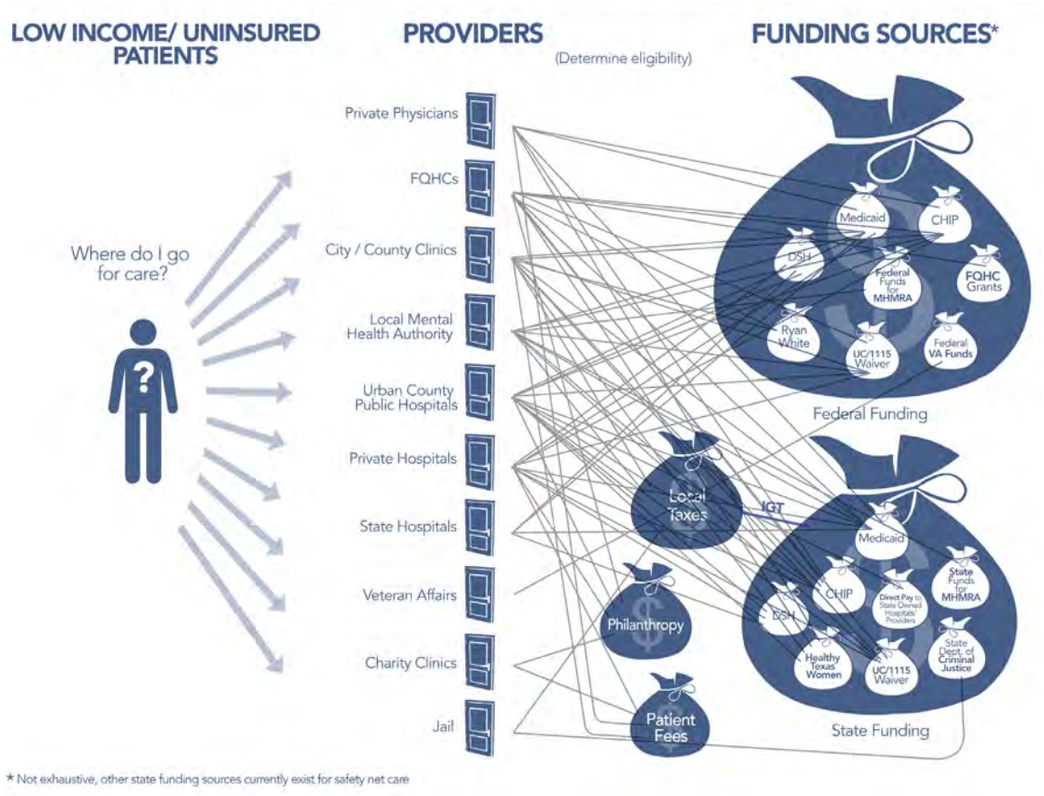


Figure 1.50 Current Fragmented Safety Net System.
Source: Community Health Choice (Janda, 2014).

Case Example:
Los Angeles County's Housing for Health Program In 2016, the Los Angeles County Board of Supervisors approved the LA County Homeless Initiative recommendations, which included 47 strategies to combat homelessness.152 Strategies allowed for the expansion of programs and services, like the Housing for Health Program. This program is a locally funded rental subsidy program that uses health care dollars to provide housing to high cost, high utilizers of health care. The program has created over 4,000 housing units, with their goal of achieving over 10,000 housing units by the end of 2019. The units are for people who were previously in hospitals, emergency rooms, and clinics. Providing this service has been shown to reduce costs to the public health system incurred by a relatively small, but costly cohort of individuals who remained hospitalized for a longer period of time due to their lack of housing upon discharge.

Investments to the root causes of health must be flexible and locally augmented to allow for innovative leveraging of funds and dual use. "Wrong pocket investment" into systems-level barriers to health requires advocacy and clearer recommendations to state and federal rulemaking on the funding decisions that constrict the healthiest options for Harris County. Although funding may be designated to a specific program, leveraging resources is often constricted by earmarking of allocated funds and grants from the state and federal government. For example, though the U.S. Department of Housing and Urban Development (HUD) may fund and reimburse for a lead paint investigator, these investigators are only allowed to investigate single-family homes, and multi-family housing only when cases of poisoning are confirmed. To investigate playgrounds or water fountains where lead may be found, no mechanisms exist within existing funding constrictions. However, if HUD funds were augmented with local dollars, that same lead paint investigator could leverage their expertise to investigate multi-family housing, playgrounds, and water fountains, while still ensuring HUD-funded outcomes are delivered upon.

Value and reimbursement in health care can be determined through strong, quickly measurable, clinical outputs which can be data mined within an existing health IT infrastructure. However, the local health system lacks the flexibility to measure the long-term health effects of building community capacity for prevention and is often not incentivized to share such information with other health care and public health partners. Chronic high blood pressure, for example, that is exacerbated by lack of access to fresh food, unsafe and unwalkable communities, or high deductibles for medication and preventive care cause a community to suffer the cost burdens of frequent hospital, EMS, and ED visits.

Most clinical output or value reimbursements are not directly rewarded for a safe, accessible grocery store with fresh food, which is an implied requirement before any health education opportunity can be appreciated. Public health, through countywide health initiatives, especially in infrastructure, can offer the data tracking and governance capacity to accurately measure the long-term health outcomes. With added investment and focused bi-directional data sharing, public health can move to become an innovative partner in determining the fiscal implications to the health care system. In this case, public health begins to move the discussion and transformation from health care and downstream issues to true "health" and prevention.

Harris Care

Although an ounce of prevention is better than a pound of cure, accessing preventive and primary health services for many Harris County residents remains difficult. Harris County has the highest rates of uninsured or underinsured individuals in the United States and has a shortage of primary care providers, further exacerbating the difficulty.

Locally innovative and alternative mechanisms to address the affordability of care and tackle lack of coverage, compounded by the state's decision to decline Medicaid expansion, are keys to the roadmap for the future. A new way in which Harris County could explore investing in preventive care would be by setting up a locally-funded model built on the experiences of other local and national models like those set up in Los Angeles and New York City, respectively. This model – which the authors term *Harris Care* – would provide coverage options that can initially help increase awareness of which third party or government program an individual may be eligible for and make this type of preventive care more affordable.

The need for addressing the affordability of care for both residents and local government is great and data indicates the need is disproportionately distributed across the county. Access to care barriers include: low awareness of existing programs and services for the uninsured, inability to afford premiums required to utilize existing programs and services, and a lack of preventive or primary care for the uninsured population. With a model like *Harris Care*, local government can enhance awareness of existing products, and subsidize coverage for residents who either are ineligible for existing programs or can't afford their premiums even with private coverage. The model will also develop and oversee new programs and services designed to provide care to the uninsured and indigent population.

The cost to both the health system and Harris County government for preventable hospitalizations, especially that portion which is unpaid for, offers insight into the need to better cover indigent and uncompensated care early with preventive services. As such, *Harris Care* would work in a complementary manner toward the goal of increasing overall health care system capacity in the provision of preventive and primary care within Harris County. And it would go further in bringing more resources into the overall health care system. This would be similar to other models across the nation by reducing the portion of uncompensated care. While this study positions the concept of *Harris Care* as a potentially viable delivery model, it will be necessary to explore and review other best practices in detail to ensure how this kind of model can improve the health and well-being of Harris County residents.

Case Example:
Los Angeles County: My Health LA (MHLA) is a no-cost health care program for people who live in Los Angeles County. MHLA is free to individuals and families who do not have and cannot get health insurance, such as Full-Scope Medi-Cal (California's Medicaid). Health care services are provided by non-profit clinics called "Community Partners." There are over 200 Community Partner clinics in My Health LA.


Mobile Market
Public Health
INTERN

Case Example:
New York City: NYC Care is a recently created program as part of the city's Guaranteed Care commitment that will be implemented by the end of 2020 for residents who have lived in NYC for six months or more and do not have an affordable insurance option, or who are ineligible for insurance. The $100 million program provides access to NYC Health + Hospitals for all residents regardless of ability to pay or immigration status (e.g. access to NYC's Public Option, MetroPlus- or direct access to the NYC Care program-the nation's largest public health care system). The health system will invest $450,000 to partner with community-based organizations to reach New Yorkers eligible to participate in NYC Care. The money will fund outreach workers who will conduct direct, grass-roots outreach to targeted populations in culturally appropriate ways to enroll and make appointments. NYC Care will provide primary care providers, access to specialty care, prescriptions, mental health services, and cover hospitalizations. This is part of a health transformation from a predominately hospital, emergency department-based system to a primary care focused model.[153]

Case Example:
San Francisco: Healthy San Francisco transformed a traditional safety net into a coordinated care system that provides access to care for city residents over age 18 who make up 500% of the Federal Poverty Level and who have no other health coverage option, including undocumented residents. The local municipality created a non-insurance-based care network that provides transparent pricing, defined benefit packages, and an expanded network of providers within San Francisco. It is not an insurance program, but rather a program with a specified group of providers within a local network to deliver services. They have enrolled about 70-89% of uninsured adults, with a patient satisfaction of over 94%. Their program also sees less unnecessary ED visits (7.9%) compared to Medicaid managed care recipients (15%), due to their focus on primary preventive services.

Conclusion

Many of Harris County's public health agencies are unable to meet the rising demand of providing care. Funding is limited for health care and the cost of providing basic health care services continues to rise. For example, Harris Health reduced the number of individuals that were eligible for care just to balance an unwieldy budget.

These health care dollars can be better utilized by creating an efficient system of managing care at all levels and coordinating care through an initiative such as *Harris Care*. It can operate as an umbrella system leveraging already existing agencies such as Harris Health and Community Health Choice and filling in gaps as needed to ensure that all residents access preventive services prior to availing emergency services.

It should be noted that Harris Health currently offers a type of insurance program that provides access to primary care services for low-income residents and includes assistance in paying premiums for insurance plans. This is done in tandem with a massive expansion of primary care services.

Community Health Choice is a managed care organization ---a non-profit health insurance company created by Harris Health in 1997. The intent was for Community Health Choice to address the issue of uncompensated care by providing Medicaid coverage for eligible Harris County residents. Due to licensing requirements imposed by the Texas Department of Insurance, Community Health Choice serves over a dozen counties in addition to Harris County and thus, its service area is much larger than Harris County alone.

Harris Health and Community Health Choice are two examples of Harris County's health partners that provide care to the uninsured or underinsured residents of Harris County. However, there remain many gaps in coverage and a certain percentage of residents only see a doctor in the ED. This emergency use of limited health care dollars can be better directed towards preventive care. *Harris Care* could fill in the gaps and find resources, including funding for those Harris County residents that cannot be serviced by Harris Health or Community Health Choice. *Harris Care* could leverage its partnership with Harris County organizations or agencies to better manage care for the entire Harris County patient population. Table 1.13 offers insight on modern models, providing policymakers with potential options to explore. It is worth noting that additional fiscal and legal analysis would be required to determine the feasibility of adopting any particular model in part or whole.

Table 1.13 Modern Models of Ensuring Access for All

Location	Year Formed	Initial Cost	Uninsured Residents	Cost per Uninsured Resident	Comments
New York, NY	2019	$100 million	600,000	$167	Providing $100 million every year to help the hospitals cover the cost of treating enrolled residents.
Los Angeles, CA	2014	$55 million	146,000	$377	Includes health care services and dental services. Initial funding covered about 20% of uninsured residents.
San Francisco, CA	2008	$140 million	60,000	$2,333	Funded by the city, the federal government, patient co-payments, and fees imposed on certain San Francisco businesses; does not cover dental and vision care.

Table 1.13 Modern Models of Ensuring Access for All.
Source: NYC (Reuters, 2019); San Fransisco (SFGate, 2013); Los Angeles (Hospital Association of Southern California, 2014).


St. George Hospital



"Health and wellbeing for a place as complex as Harris County requires a combination of good science and assessment, but even more so deep engagement of community members with lived experiences"

—Dr. Alonzo Plough
Chief Science Officer and Vice President
Robert Wood Johnson Foundation

5

Voices Heard By HCPH

No health assessment is complete without intentional incorporation of input and guidance from residents and partners within the community. Harris County Public Health has gathered community input for this study from several approaches to inform the content and recommendations for transforming health and building resilience in Harris County. Community residents throughout the county have provided a wealth of knowledge and guidance through surveys and interviews specific to this study and through tools that have been a part of HCPH's mission for several years. To better describe the health system, Harris County residents from each precinct have shared unique and intimate details on their experiences navigating health systems when care was needed. Their stories are spread throughout this study. Over one hundred leaders of partner institutions in the health care, academic, social services and community development, state and national, and philanthropic sectors offered their feedback and subject matter expertise on health issues as well as sharing their view on the role of local government in seeking solutions. Extensive interviews with cohorts across local government offered insight into the feasibility and appetite for solutions to better coordination and good health in Harris County. These interviews with local government have unlocked opportunities for further collaboration and have augmented existing frameworks for future communication.


YOUTH DENTAL
Ozarka

Harris County Residents

Community responses that are highlighted within this study include systematic surveys performed in 2015, 2017, and 2019. Since 2015, HCPH has surveyed 1,689 residents at their homes in disaster prone neighborhoods through CDC's Community Assessment for Public Health Emergency Response (CASPER) assessment process. This well-recognized survey tool helps county leadership identify the vulnerability, public health risks, needs, and resiliency of communities. Once communities are identified, clusters are grouped, and a systematic random sampling is applied to determine who is approached. The gathered data informs community specific profiles and interventions that complement the unique needs of a diverse Harris County and is a resource for countywide collaboration. CASPERs have been completed in several neighborhoods of each precinct and are explored further in the next section, *Building Resilience in Harris County*.

As part of HCPH's Community Health Improvement Plan process in the fall of 2017, HCPH developed a five-year countywide strategy to prioritize health needs that were identified by county residents and stakeholders. The Community Health Improvement Plan is a comprehensive roadmap that includes strategies and short-term, intermediate, and long-term goals to guide the overall work of Harris County stakeholders. Almost 2,500 residents across Harris County were surveyed. They shared that the three most important health issues to them were chronic disease, mental health, and obesity, which parallels the three most important health issues identified by over 100 partners in this report. Of note, these issues differ from the top three causes of death in Harris County: heart disease, cancer, and accidents.

Additionally, in 2019, at the Food Safety Summit, One Health Conference, and other public engagements, staff from HCPH surveyed community members to better understand their public health concerns and priorities. The data collected at these events makes sure that HCPH is, first and foremost, serving the needs of the people. Without these continual touchpoints, HCPH would not be able to strategically orient its mission, vision, and values for cornerstone documents such as the Strategic Plan, Community Health Improvement Plan, and this study.

Several residents from each precinct were called and asked to participate in phone interviews to describe their experiences with the health system and barriers to health in Harris County. Their stories are spread throughout this study. Each resident has provided a unique voice for health problems that are far too common.

Harris County Partners

In addition to community members countywide, HCPH has reached out to over one hundred unique institutional stakeholders and partner agencies with the framework of health happening "where we live, learn, work, worship, and play" ("LLWWP") to gather feedback on the strengths and challenges to addressing the top health issues of Harris County, how they view the primary roles of a public health department, and specific suggestions on how to improve the role of Harris County government in addressing health issues. Their responses, categorized by sector (academia, health systems, philanthropy/economic development, social services/community development, local government, state/national stakeholders, etc.) have been enlightening and will continue to drive and inform the work of HCPH.

HCPH partners were asked to identify the top three major health issues and the strengths and barriers to addressing them (Figure 1.51). The top major health issues identified by partners were diabetes, obesity, mental health, and cardiovascular health**.** Although these issues vary from the top causes of death in Harris County, they identify perceived threats to Harris County that strain community stakeholders and the communities they serve.

"During the delivery of my child I had to be my own advocate and follow the paper trail because of repeat billing and miscoded billing between primary and secondary insurance plans. That required a line by line overview. I can't imagine what that could mean to someone more vulnerable than me."

—Precinct 1 Resident

Major challenges serve as a barrier to addressing these health issues (Figure 1.52). Access is consistently recognized as a barrier to health, especially in terms of the "three A's of access" (availability, acceptability, and affordability), and lack of prevention funding. Access and lack of prevention funding overwhelmingly received consensus by partners as a barrier. However, other barriers such as data sharing, political will, social determinants of health, jurisdiction and governance, discrimination, and transportation go beyond traditional public health and health care interventions. These barriers require systems-level change. When combined, these barriers can be grouped as systems-level barriers and are the overwhelming challenge to addressing health.

Stakeholders indicate that the Harris County community, especially in the philanthropic sector, is on the cusp of focusing on systems-level strategies through collaboration. This need is described best by the aforementioned BARHII framework of health equity which articulates the need to focus on collaboration between systems and policy/procedure change to gain better population level health outcomes.

As stated in the Business Case for Transforming Health chapter above, $10 of increased public health spending per capita can drastically cut health care costs to local, state, and federal governments. In the spirit of these findings, HCPH partners were asked "*If you were given $10 today, how many of those dollars would you spend on preventive types of services and how much would you spend on health care delivery?*"

Currently, local, state, and federal governments spend $0.25 on public health for every $10 spent on health care per person per year. On average, HCPH partners indicated wanting to spend about **$6 on public health and $4 on health care**. Health systems indicated the lowest mean value of wanting to spend $5.50 towards public health and philanthropy indicated the highest mean value with $6.40 (Figure 1.53). Though the vast majority of dollars are currently spent on health care delivery, the respondents felt that there should be a transformational shift toward an investment in prevention services to improve health in Harris County.

It's clear that respondents thought investment should shift from reactionary "sick" care towards public health and preventive care. Investment in prevention is the first step in a system-wide change. Should policymakers advance on this study's recommendation to streamline and integrate service delivery across fragmented departments, a shift towards upstream health could be more seamless if done within a single agency's budget. If fragmented service delivery across departments within the county (and city) continue as separate entities, then any proposed shift could potentially increase tension among departments as each argues to maintain or grow its individual budget.

Of note, when categorized by industry, all indicated that environmental health should be the main focus except those in health systems who shared that environmental health should be ranked third. Additionally, during the survey administration, some stakeholders noted that although provision of health services is a public health priority, it may not be necessary for a public health department to provide health services and should be left to community-based clinics and safety net providers. The near-universal prioritization of environmental health underscores this report's recommendation for infrastructure projects to increase their focus on health.

Figure 1.51 Major Health Conditions Impacting Health

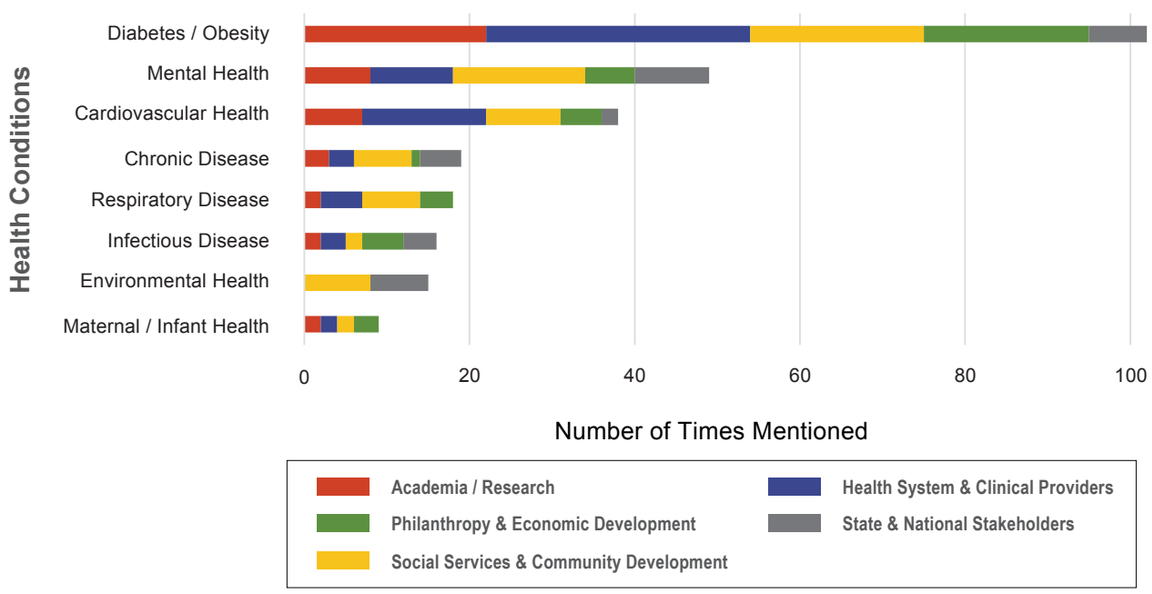


Table 1.51 Major Health Conditions Impacting Health by Organization Type, Harris County, TX, 2019.
Source: Health Studies Community Health Survey, Harris County Public Health, 2019.

Figure 1.52 Major Challenges to Addressing Health Issues

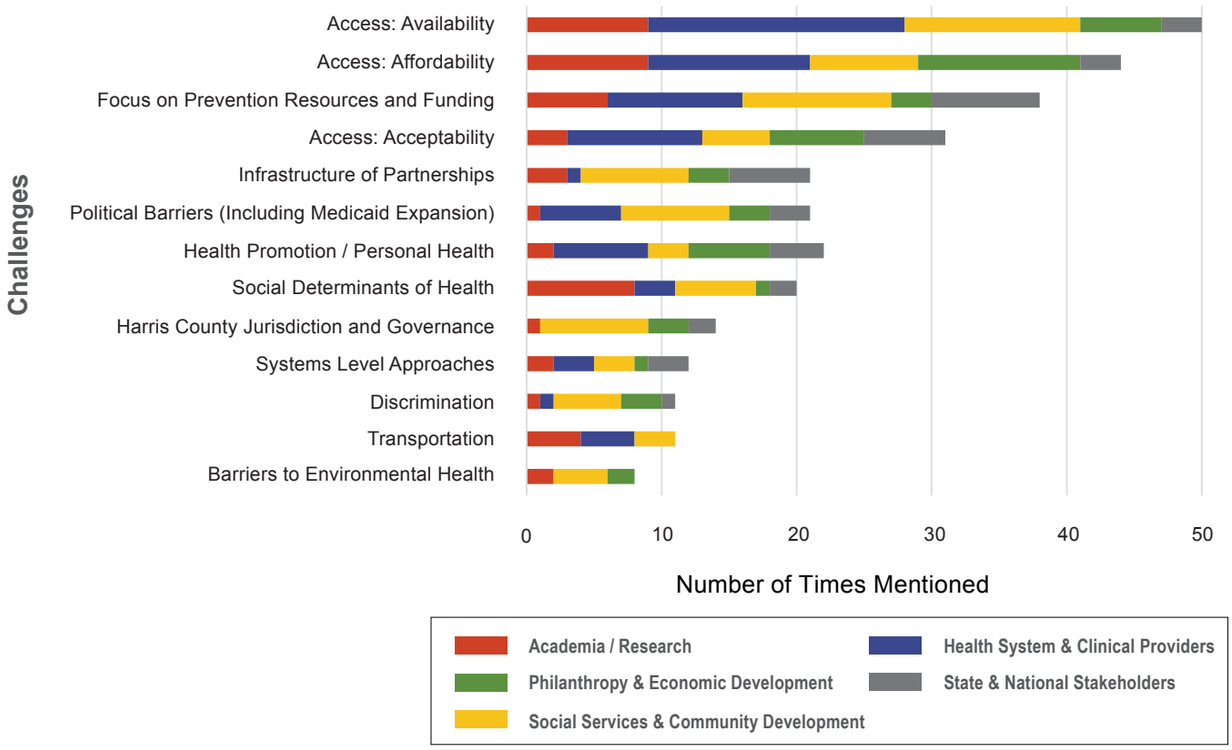


Table 1.52 Major Challenges to Addressing Health Issues by Organization Type, Harris County, TX, 2019.
Source: Health Studies Community Health Survey, Harris County Public Health, 2019.

"For me health care is affordable, but the medications aren't. I had to use one medication for my cancer that without insurance, the copay would have been $300 per month. Growing up, I lived in a border town, and when I was younger we would go across the border for any type of care we needed."

—Precinct 4 Resident

HCPH partners have indicated that the focus of a public health department should be on:

1. Environmental Health
2. Infectious Disease Prevention and Response
3. Provision of Health Services
4. Promotion of Healthy Behaviors
5. Emergency Preparedness

"Health means no more pain, no more sickness, and no more doctors all the time."

—Precinct 3 Resident

"With government health care, they brush me under the rug. Even when I try to get myself right and do the paperwork."

—Precinct 2 Resident

Figure 1.53 Resource Allocation

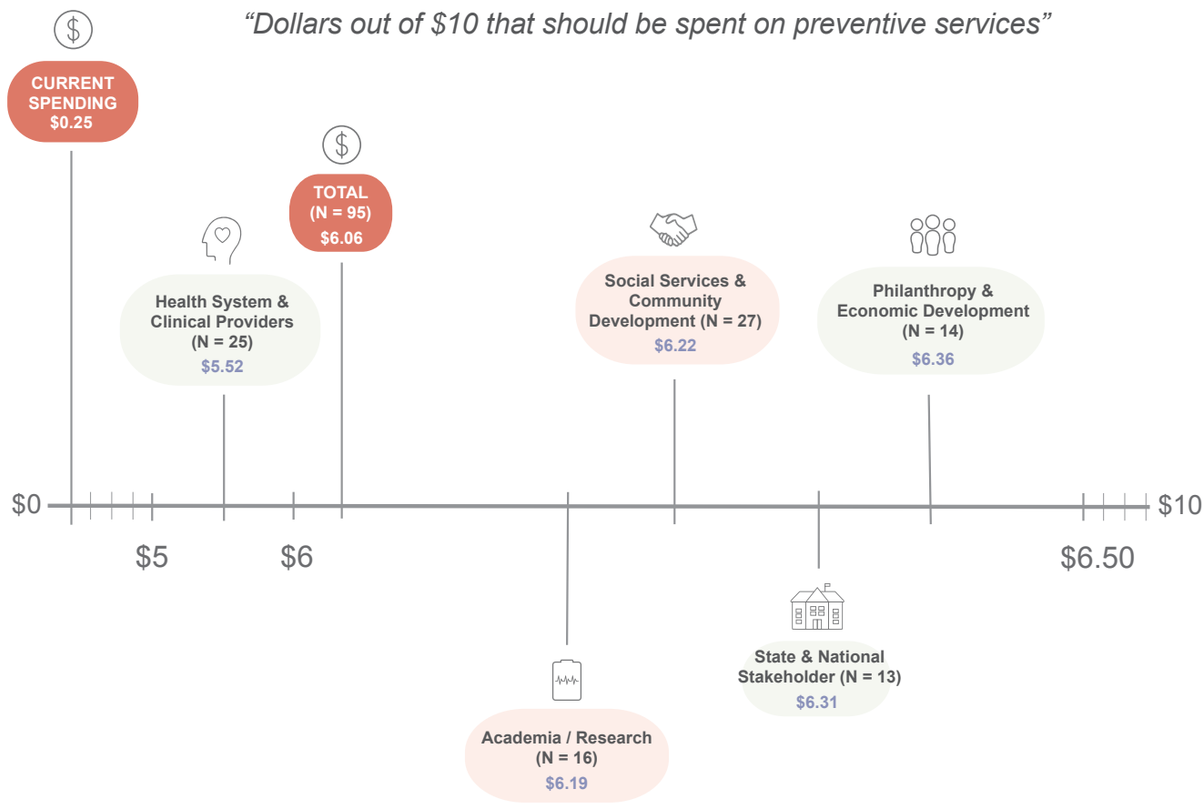


Table 1.53 Resource Allocation by Organization Type, Harris County, TX, 2019.
Source: Health Studies Community Health Survey, Harris County Public Health, 2019.

Harris County Government

When seeking feedback from HCPH partners, HCPH recognized the need to dive deeper into collaboration with cohorts for better governance. These cohorts, comprising of directors and/or executive staff of several county departments, were asked to participate in a half hour to 1.5-hour key informant interview.

Across sectors, county departments presented a consistent interest in a common agenda to align efforts across local government to improve health. In recent years, it was noted that county entities are finding more ways to collaborate, notably in emergency response and jail health/jail diversion. However, there remains significant area for improvement. In fact, improved coordination was consistently named as a change needed in county government. Specifically, there is great potential to enhance the coordination of personal health and social services for clients across entities being served by Harris County such as HCPH, Harris Health, Harris Center, Community Services Department (CSD), Institute for Forensic Sciences (IFS) - especially in work such as, victim assistance, forensics, and cause of death data. The Harris County Sheriff's Office (HCSO), Flood Control District (home buyouts, etc.), and Engineering (permitting, etc.) are also potential areas of opportunity.

As a funding clearinghouse, CSD also has a unique vantage point of seeing gaps in collaboration (e.g. for community development block grant funding). This was noted to be important when agencies like Harris Health and HCPH have competing proposals. One county department noted there is no mediator in charge of overseeing collaboration. By creating a dedicated office, this study terms as *Office of Health Integration and Outcomes*, the county can prioritize and further targeted and streamlined collaboration. However, a significant barrier to coordination is that many county entities expressed a need for education and awareness of what other Harris County entities do. For example, many entities, public and private, are not aware of emergency financial services offered through the CSD. Similarly, through the HCSO, residents who cannot afford a car seat can receive one for free (through a partnership with Texas Children's Hospital). The work happening across the spectrum in education and community outreach by the Harris County Public Library (HCPL) is complementary to health-related issues.

Conclusion

These concerns across county departments reinforce the need for targeted and coordinated systems change utilizing the frameworks outlined in the beginning of this chapter. Utilizing these frameworks and recommended points of action outlined in Transformative Recommendations offer the opportunity to build a shared agenda and for an increased awareness of department overlap for streamlining and efficiency.


Harris County
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“When we value the interconnectedness of who we are are, it helps us to transform into the healthiest communities.”

—Dr. Nadine Gracia
Executive Vice President and COO, Trust for America’s Health

6

Transforming Health In Harris County

Snapshot of Health in Harris County

Figure 1.54 Harris County Life Expectancy

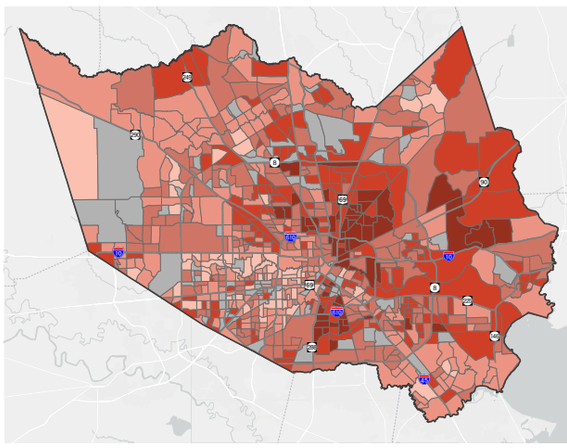


Figure 1.54 Life Expectancy by Census Tract, Harris County, TX, 2010-2015.
Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2010-2015.

Life Expectancy (Years)

- 60.7 - 73.0
- 73.1 - 76.3
- 76.4 - 79.1
- 79.2 - 82.3
- 82.4 - 89.7
- Data Unavailable

Figure 1.55 Adults Who Smoke Cigarettes (%)

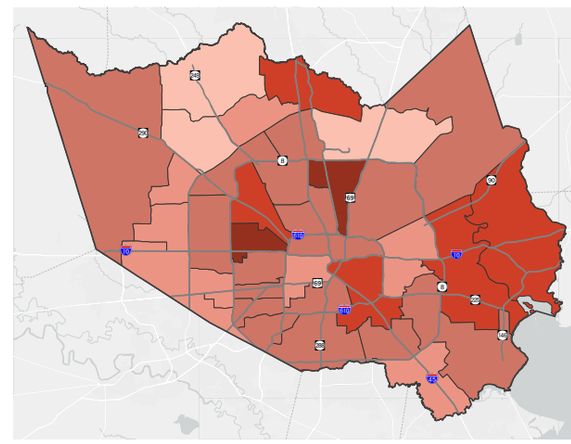


Figure 1.55 Percentage of Adults Who Smoke Cigarettes At Least Some Days by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Adults Who Smoke Cigarettes at Least Some Days

- ≤ 9%
- 10 - 11%
- 12 - 16%
- 17 - 20%
- 21 - 24%

Figure 1.56 Adults Who Had Poor Mental Health (%)

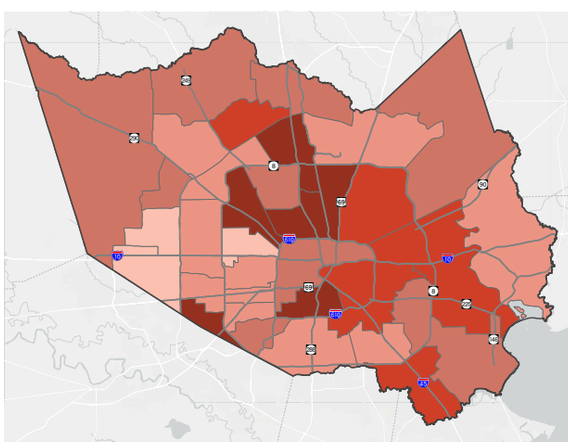


Figure 1.56 Percentage of Adults Who Had 14 or More Days with Poor Mental Health in the Past 30 Days by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Adults Who Reported ≥14 Days with Poor Mental Health in the Past 30 Days

- ≤ 10%
- 11 - 13%
- 14 - 16%
- 17 - 18%
- 19 - 22%

Figure 1.57 Children Without Insurance (%)

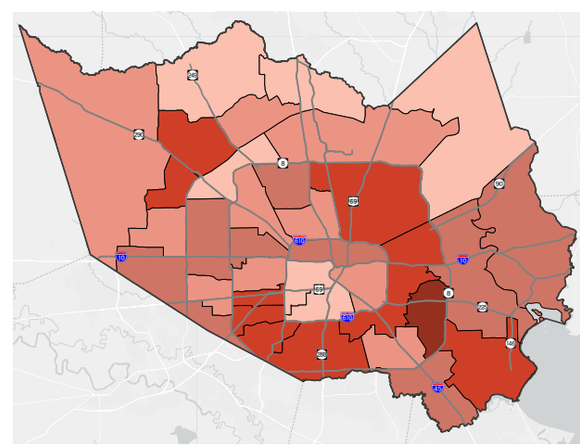


Figure 1.57 Percentage of Children Without Insurance by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Children Without Insurance

- ≤ 3%
- 4 - 8%
- 9 - 14%
- 15 - 22%
- 23 - 35%

Figure 1.58 Adults with Low Physical Activity (%)

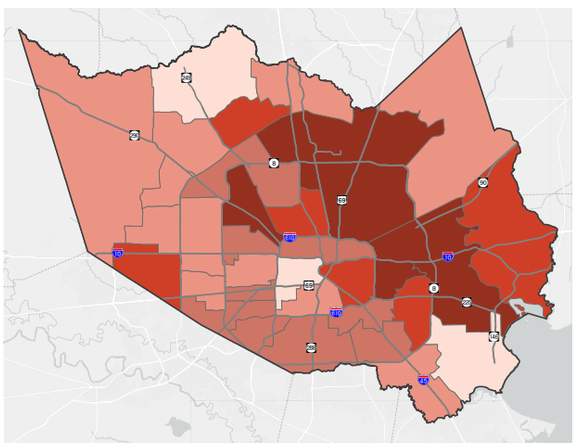


Figure 1.58 Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines

- ≤ 31%
- 32 - 38%
- 39 - 42%
- 43 - 46%
- 47 - 55%

Figure 1.59 Adults Who Are Classified as Obese (%)

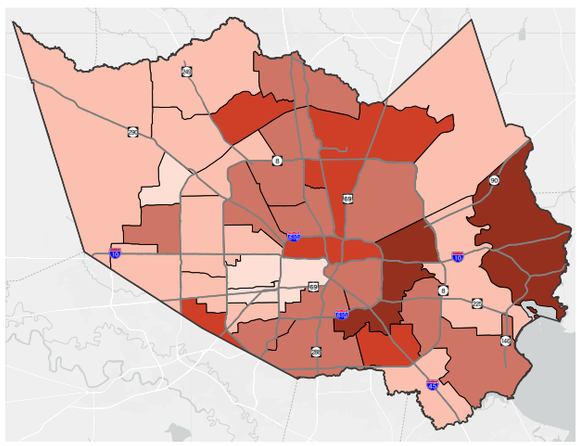


Figure 1.59 Percentage of Adults Who Are Classified as Obese by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Adults Who are Classified as Obese

- ≤ 20%
- 21 - 29%
- 30 - 32%
- 33 - 40%
- 41 - 51%

Figure 1.60 Adults with Diabetes (%)

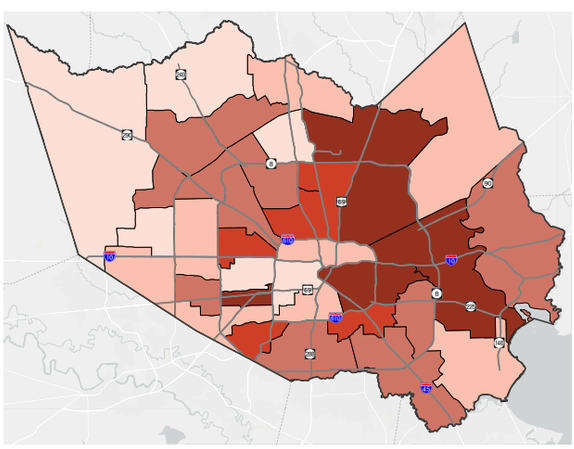


Figure 1.60 Percentage of Adults with Diabetes by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Percentage of Adults with Diabetes

- ≤ 7%
- 8 - 11%
- 12 - 14%
- 15 - 18%
- 18 - 26%

Figure 1.61 All Preventable Adult Hospitalizations (%)

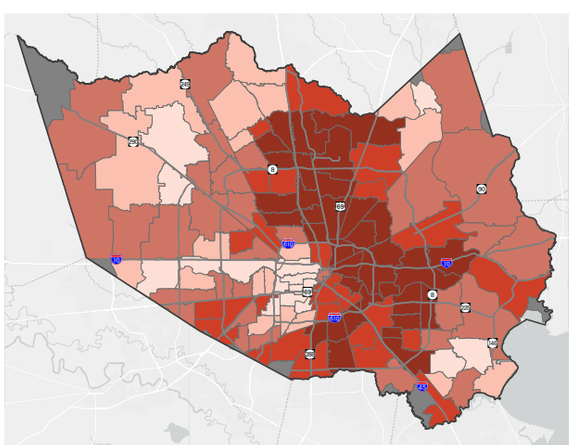


Figure 1.61 Percentage of All Preventable Adult Hospitalizations by Zip Code, Harris County, TX, 2017.
Note: Methodology to identify preventable hospitalizations was developed by the Agency for Healthcare Research and Quality (AHRQ).
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Percentage of Preventable Adult Hospitalizations

- ≤ 3.0%
- 3.1 - 3.9%
- 4.0 - 4.8%
- 4.9 - 5.7%
- 5.8 - 7.1%
- Data Unavailable

Transformational Recommendation

1.

Drive systems-level change through prevention and upstream focused solutions that incorporate health and social services in a more integrated and effective manner.

Health is holistic, complex, and multidisciplinary in nature. One's zip code is a better predictor of health than one's genetic code, so to achieve better health at the population level, solutions must be directed at the systems level.[154] *Governance, prioritization, and coordination of county resources should advance the health of all residents.*

1.1. Create a culture of health through investments in "upstream" or public health prevention approaches that target the social determinants of health (education, economic empowerment, housing, access to fresh foods, transportation, safe places to engage in physical activity, etc.) to mitigate more "downstream" or expensive health care costs to the system and make health a shared value of Harris County.

1.2. Create a countywide health-related initiative (through a formal governance structure such as a health coordinating council) that includes multidisciplinary department and stakeholder representatives with the objectives of improving community health and resilience and fostering cross-sector collaboration.

1.3. Identify countywide infrastructure projects (flood mitigation, housing, roads, parks, etc.) that would benefit from broad multidisciplinary teams in planning, implementation, and opportunities for optimizing community health impact and creating healthier, more equitable communities.

1.4. Support efforts to integrate Health Impact Assessments and other similar health reviews in the planning and implementation phases of countywide infrastructure projects, and partner with entities in academia, faith-based institutions, nonprofits, and other stakeholder groups to implement healthier options that improve population health and well-being.

Harris County has limited resources to protect the public's health and well-being. And there are serious challenges facing the community (See 8 figures 1.54 - 1.61). Those limited resources can be stretched further if investments in prevention and upstream factors prevent downstream health burdens. The importance of such reallocation of investment was heard repeatedly in the key informant interviews. However, such changes will likely require serious political will to overcome existing bureaucratic, technical, and other barriers.

Nevertheless, **unless the system changes in meaningful ways, some residents can continue to anticipate a shorter lifespan just for being born in the "wrong" zip code.** To make this change, Harris County leadership should convene leaders and key stakeholders in housing, food security, transportation, mental health, health care, public health, and others to develop a specific plan to address downstream problems with upstream interventions.

A countywide health initiative, adopted by Commissioners Court, could help bring all relevant government departments and stakeholders that impact health to the table to discuss improvement of coordination, collaboration, and communication. This initiative could draw from overlapping elements of existing community health assessments such as Harris Health's CHNA, HCPH's CHA, etc. to develop a single set of shared goals and objectives as well as an inventory of health-related programming. Once relevant existing programs and services are identified, work could begin to build multidisciplinary, interagency teams to achieve identified goals.

Due to the impact of the built environment on health, this study strongly encourages any adopted countywide health initiative to focus on infrastructure projects in a more vulnerable community as well as adopt a policy to integrate health impact assessments and reviews for proposed and planned infrastructure projects. The countywide health initiative, as well as the joint CHNA, could be directed by an entity such as a "Health Coordinating Council" created by Commissioners Court.

Harris County's health care infrastructure is, by some standards, the biggest and best in the world. TMC boasts over 10 million patient visits per year and over 9,200 patient beds.[155] Yet many neighborhoods surrounding TMC are considered MUAs, in part because health care access and infrastructure are not uniformly or equitably distributed in these communities.

Transformational Recommendation 2.

Coordinate delivery of existing health care services to ensure efficiency and effectiveness and develop new health care infrastructure in higher need areas to improve access to health care across the community.

Access to health care continues to be a barrier as noted by residents and by data in this study. Investment into both "brick and mortar" infrastructure and rapidly deployable, flexible alternatives to care can increase the availability of resources, especially in times of an emergency. While health care infrastructure investment cannot change health outcomes of communities within Harris County alone, it is an important element for ensuring provision of health care delivery within these very communities.

2.1. Conduct a feasibility study on the investment in large-scale health care delivery infrastructure such as anchor hospital(s), etc. where there are federally designated MUAs, demonstrable lack of health care access, and where there is a high risk for large scale, industrial public health emergencies (train derailments, chemical fires, plant explosions, etc.).

2.2. Enhance existing or create additional community clinics that focus on preventive services and are co-located with public health, mental health, and social services. This access to preventive services can divert unnecessary emergency department visits that are especially critical during an emergency.

2.3. Invest into leaner, versatile alternatives to "brick and mortar health" care infrastructure, including mobile health vehicles, telehealth, and other innovative technologies, which can also be rapidly deployed during an emergency event. These resources can address the needs of areas with low population density.

2.4. Expand access to specialty care such as dialysis and mental health resources in a way that builds resilience before, during, and after emergencies and is equitable in times when there is no emergency.

Harris County's population has been growing faster than nearly any other community in the United States for several years. These new residents put additional strain on the already taxed health care infrastructure particularly for those who are under- or uninsured. As Harris County's population grows, so too must its health care infrastructure. For some neighborhoods, particularly those with higher levels of affluence, this has certainly been the case.

However, in other areas, especially those with lower life expectancies, higher rates of under- and uninsured, and designated as MUAs, there has been a stagnation in infrastructure development. These same areas are often Harris County's most vulnerable, as calculated by CDC's SVI, a tool to identify communities that may need additional support to protect against hazards and poorer health outcomes. They tend to have higher levels of obesity, more days with poor mental health, more likely to be diagnosed with diabetes, and have higher travel time to hospitals, to name just a few of the issues.

As reinforced previously, access to health care includes three domains: **Availability, Acceptability, and Affordability** (these are referred in this report as the *"Three A's of Access"*). Many communities in Harris County do not have necessary health care infrastructure. In many cases, the private sector has not invested into their community due to business model considerations. It is in these neighborhoods that a public safety net hospital or clinic can have the most impact. For neighborhoods without the population density to support brick and mortar solutions, investment in telehealth and mobile health strategies can ensure health care is available to them on either an episodic or continued basis.

Harris County has already taken many steps to improve on this landscape. The number and utilization of community clinics has grown since 2008 for example.[156] Building off this success should continue, with more investments in necessary and thoughtful health care infrastructure such as hospitals, FQHCs, and community clinics. Safety net health care institutions should position their investments where the need is greatest, especially preventive and primary care clinics in areas with a high percentage of uninsured residents.

Additionally, Harris County should encourage the growth of secondary care clinics, including dialysis centers, mental health clinics, as well as specialized care in other sectors such as dentistry, vision, veterinary, etc.

As described later, in the upcoming Emergency Preparedness chapter, investments in health care infrastructure are equally investments in community-wide and even individual level resilience. Resilience is a community or individual's ability to withstand an adverse situation and then "bounce back." During emergencies, having close access to health care institutions can save lives, especially those institutions that can offer more specialized care such as emergency, surgical, dialysis, etc. Given the sheer number of emergency type events, both natural and manmade, that Harris County has faced on a repeated basis over the years, community resilience is of particular importance to future planning for health and health care delivery within Harris County. Frequent flooding events have shown that interrupted access to dialysis centers, for example, poses a serious threat to health as well as a significant burden on the health care system.

Transformational Recommendation 3.

Enhance the safety net system to better address the ongoing health needs of Harris County residents who are under- or uninsured, including through the creation of a new, robust delivery model called "*Harris Care.*"

Availability, acceptability, and affordability continue to be significant barriers to accessing health care equitably within Harris County. Financing of uncompensated care is a significant driver in overall health care system costs. County government can play a key role in developing innovative methods of delivering or paying for care. Such methods can in turn incentivize positive population health outcomes to position the safety net system to be more resilient to shifting health care policy at the state and federal levels.

3.1. Advocate with local, state, and federal partners for key policy changes including Medicaid expansion, 1115 Waiver renewal, and explore requesting a 1332 Waiver through the state to increase the number of eligible Harris County residents for health insurance coverage.

3.2. Examine the potential impact and cost/benefit of creating a new, locally driven delivery model called *"Harris Care,"* a local health care funding mechanism that would ensure access to low or no-cost primary and preventive care services for the uninsured population through enhanced coordination of existing and future infrastructure/programs designed to address their identified needs.

3.3. Explore a feasibility study to scale up existing programs or create new programs adopted from the best practices and strategies utilized in other communities —whether across the nation or globally—to address the health care needs of populations who are otherwise unable to afford or are ineligible for private insurance, Medicaid, Children's Health Insurance Plan, other government programs, etc.

3.4. Conduct a countywide awareness campaign for community members and health care providers alike on updates associated with changing state and federal rules on enrollment and eligibility, including public charge, that identifies resources and legal assistance available to address identified concerns and advance health equity.

For reasons beyond the scope of this study, **Texas remains a Medicaid non-expansion state.** As such preventative and primary care through Medicaid is beyond the reach of 20% of Harris County residents.[157] Put differently, uninsured rates in Harris County still means that nearly one million residents do not have health insurance. However, the Emergency Medical Treatment and Labor Act's (EMTALA) requirements that anyone coming to an ED must be stabilized and treated, regardless of the person's ability to pay, guarantees their access to significantly more expensive emergency health care services. This means that Harris County taxpayer bears the cost of poor health access for the uninsured in Harris County just by the fact that the system is designed such that prevention and primary care is not valued; rather coverage is "provided" when one is sick or injured further downstream in the "sick care" system. This phenomenon is not a local one alone and the lack of prevention incentivization as a core challenge is repeated across the country.

Harris County should explore expanding its several existing options for low-income residents to receive primary and preventive health care services, most notably through Harris Health's Financial Assistance Program (formerly the "Gold Card" program). The Financial Assistance Program does not provide insurance, rather it offers access to care to eligible low-income residents. One alternative method to address the uninsured population is to consider creating a managed care network with financing for uncompensated care delivered in clinics throughout Harris County that includes county and city clinics, FQHCs, nonprofit clinics, mental health services, and contracts/affiliation agreements with medical schools, hospitals, community social services, and housing partners to provide expanded coverage.

A centralized network could improve fiscal stability via contracts with insurance companies to pay appropriate rates, improve billing, ensure proper medical coding, and improve navigation and access throughout the network. The health network could then function as a primary care-focused system to reduce overall costs and move away from a predominantly hospital and emergency department-based system. A primary care-focused system could result in a multitude of beneficial outcomes, including improved patient outcomes, a more equitable distribution of health in populations, lower overall costs, reduced ED use, and higher patient satisfaction. Alternative financing mechanisms could then be employed and utilized to cover gaps in existing payor models in Harris County. Examples of existing models from across the country could be used to build such a model locally.

Large, public network models can more adequately address the "upstream" factors leading to social inequities, such as socioeconomic status, community safety, education, health literacy, housing, etc. Enhanced safety-net programs provide comprehensive benefits that are reasonable and affordable on a family budget or fixed income. Public coverage programs must promote equity in utilization, quality, and outcomes with the goal of eliminating health and health care access inequities.

While creating an indigent care financing mechanism would need careful exploration, several successful models have been implemented in communities around the United States. In 2007, San Francisco was the first local government to attempt to provide health insurance for its residents. *Healthy San Francisco* provides access to care for city residents over age 18 who make up to 500% of the Federal Poverty Level (FPL) income and who have no other health coverage option.[158] This includes undocumented residents. Coverage allows participants to access approximately 35 area community health centers and hospitals through a medical-home model. Currently, there are approximately 13,000 San Franciscans enrolled in the program. Fees are paid on a sliding scale, with an out-of-pocket cap at $1,800 per year. The program has an estimated overall total program expenditure of $50.63 million and is supported by a $38.27 million subsidy from the City and County of San Francisco General Fund. The estimated total per participant per month expenditure is $236.

MyHealth LA aims to cover Los Angeles County residents who are ineligible for Medi-Cal because of immigration status or other reasons.[159] Launched in October 2014, this program receives approximately $56 million in funding per year from the Los Angeles County Board of Supervisors. During the fourth year of the program, 147,000 residents without proof of residency who earn less than 138% of the FPL income were enrolled. This model centers around 213 clinics and community health centers with a medical-home model, in which participants can receive free primary care and health screenings, chronic disease management, and prescription medications. The estimated total per participant per month expenditure for primary care is $28.56.

Most recently, New York City implemented *NYC Care* in early 2019, which serves approximately 600,000 New Yorkers without insurance. This program aims to strengthen the public insurance option (MetroPlus) and guarantees that anyone ineligible for insurance – including undocumented New Yorkers – has direct access to a network of the city's public hospitals and clinics (NYC Health + Hospital), including their physicians, pharmacies, mental health and trauma counseling, and substance abuse services. Services are available on a sliding fee scale, and the program is estimated to cost at least $100 million annually.

Models such as those described above as well as others provide Harris County a roadmap for the locally-funded provision of health coverage for its most vulnerable, those who are under- or uninsured, especially in a state that has not expanded Medicaid and when there remains uncertainty at the federal level around the ACA. Regardless of the specific approach Harris County chooses, **there is a strong need to modernize the safety net of Harris County with a new, robust, health care financing and service model (that this study terms *"Harris Care"*) for Harris County residents who are under- or uninsured.** The resulting health network could truly function as a primary care-focused system to reduce overall costs and move away from a predominantly hospital and emergency department-based system as it is currently designed. *Harris Care* would need further exploration but would be a potentially transformational addition to the landscape of health-related financing and care delivery in Harris County.

Transformational Recommendation 4.

Align strategies across county and municipal governmental departments that impact health to improve coordination, collaboration, and communication.

Governmental agencies within Harris County serve the same population, yet their specific strategic direction and goals are not always aligned. To most effectively and efficiently drive change for the community, there needs to be improved strategic alignment amongst these agencies—as well as their counterparts that may exist in the 34 municipalities within Harris County—to address the complex drivers of health and resiliency.

4.1. Conduct a systematic review of existing grants, programs, and services of county departments and subsequently their counterpart departments in other municipalities to identify overlap and potential collaboration between and amongst various departments, whether their charge and responsibilities are directly or indirectly health-related.

4.2. Improve data and information-sharing procedures and policies to evaluate and track progress of countywide health initiatives meant to address preventable hospitalizations, chronic disease prevalence, and other population health metrics.

4.3. Encourage local health systems to conduct joint community health needs assessments to align agency missions, visions, and strategic plans, especially the four local and publicly financed governmental health systems: Harris Health System, Harris Center for Mental Health and Intellectual and Developmental Disabilities, Harris County Public Health, and Houston Health Department.

4.4. Where feasible, align parallel Harris County and City of Houston policies and procedures for matching services, programs, and eligibility requirements, especially during an emergency, to prevent resident confusion.

Misalignment of health-focused strategies leads to poorer health outcomes. The reforms to health care and public health mandated by the ACA and encouraged by reports such as *Public Health 3.0* and others have given incentives to push for health-related fields to align at the national level. As seen in projects such as the Medicaid 1115 Waiver, such alignment is happening at times organically and other times due to other circumstance here within Harris County. However, residents would benefit from focused efforts at the top levels of local government to expedite strategic harmonization.

A systematic review of existing grants, programs, and services to identify overlap could be the baseline for strategic alignment. Such a review would require information sharing and a culture of transparency. Ultimately, the authors envision that this would lead to the first ever joint CHNA between Harris Health and HCPH. Such a joint CHNA would help ensure both agencies work in concert with each other to tackle otherwise intractable community problems. Over time, other publicly-financed health agencies could also be brought to the table for such coordination.

Given the importance of alignment, especially in a post-ACA world, this study recommends Harris County **aligns strategies across county departments that impact health with better coordination, collaboration, and communication.**

Transformational Recommendation

5.

Streamline and integrate health care and prevention services across Harris County and, where feasible, the City of Houston.

Multiple government agencies work to make Harris County a healthy community. However, significant silos still exist among these agencies. There lacks a unified overall strategy to improve health. Residents find it difficult to navigate the system and to identify and access all of the available services. With the current fragmented system, accountability for health improvement is blurred. Identifying and eliminating inefficiencies in health-related activities can and will help streamline areas of service overlap.

5.1. Convene a task force to oversee an in-depth and independent review of health and social services delivered throughout Harris County across local government agencies, including in public health, mental health, safety net providers, etc., as already explored in previous community assessment reports such as the 2004 Greater Houston Partnership's *Public Health Task Force Report,* the 2017 City of Houston's *Ten Year Plan,* and others.[160,161,162]

5.2. Identify and eliminate duplicative administrative and technical resources by modifying areas of service overlap, including between Harris County and other health departments within municipalities, as well as identify opportunities to present unified data, outcomes measures, and service delivery, etc.

5.3. Improve systems interoperability to automate critical data sharing necessary both for day-to-day situations and during community responses for public health emergencies, including chemical, biological, radiological, and other emergencies.

5.4. Create a new Harris County *Office of Health Integration and Outcomes* that can guide integration of duplicative programs, services, and even departments that have an impact on health as well as oversee improvements in key health outcomes laid out in this study and beyond.

Health in Harris County is complicated. On the clinical side, residents find the system to be frustrating to work through. Within Harris County, clinical and mental health services are offered through Harris Health, the Harris Center, FQHCs, county and city public health clinics run by two separate health departments, charity clinics, state hospitals, private hospitals, and even HCSO via the jail system and Veterans Affairs. **In addition to the clinical work happening in public health clinics, public health activities are often conducted by both HCPH and HHD, for similar, if not the same, populations.** Each institution has its own set of goals and strategic objectives and each one maintains varying levels of coordination and integration with the other.

Having two large, local health departments within Harris County presents several unnecessary challenges. First, agencies compete over limited grant funding at the state and federal levels. One example that is due to CDC's opaque approach to funding: HHD is frequently eligible to apply for non-competitive grants that HCPH is ineligible for, despite that both care for similar population sizes. Once funded, it's still unclear regarding how the resources will be spent on the populations or issues outside of the City of Houston.

Secondly, epidemiological surveillance systems to detect disease outbreaks and other conditions such as substance abuse, chronic diseases, etc., are generally duplicative and unintegrated. Integration attempts by both entities has not had the desired success. And, changing or competing priorities can make a mess of matters even more.

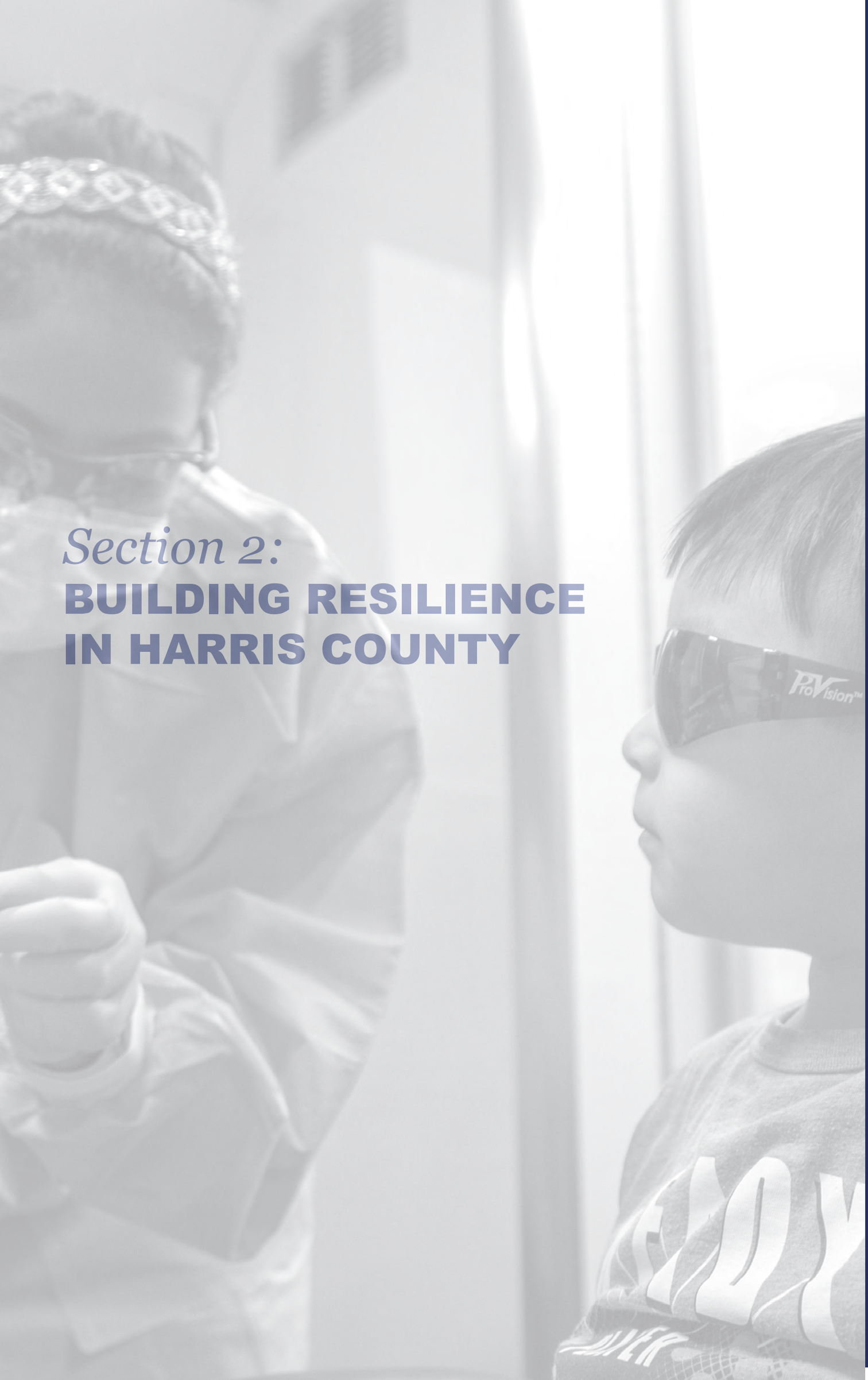
Finally, residents frequently get confused and frustrated over which health department has the jurisdiction to address their issues and even how services are delivered. Often, residents are sent from one health department office to the other because there is lack of clarity on which office is responsible for their concerns, further aggravating the issue.

With two large, comprehensive health departments providing redundant guidance and services create natural inefficiencies in the public health system in Harris County. It also speaks to the challenge of understanding who truly is accountable and responsible for public health in the overall community. In looking at governance and structure for public health departments across the nation, with the exception of Chicago and Cook County, Illinois, many jurisdictions have found that service delivery integration between city and county governments appears to have merit. Differences in governance, structure, programming, culture, etc., would have to be taken into consideration. Local exploration of these differences would make sense.

Improved integration of governmental health agencies does more than remove wasteful inefficiencies. It also presents an opportunity to enhance clinical and public health service delivery. It's easy to envision a system where patients interfacing with Harris Health are assessed for eligibility of all public health services, including smoking cessation programs or Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) eligibility. Tighter integration would also improve telehealth and mobile fleet programs, as well as offer potential savings through centralization of information technology services. Lastly, a fully unified health system should be more resilient to public health emergencies and not be caught up in jurisdictional lines and/or different philosophies.

This study also proposes the creation of an *Office of Health Integration and Outcomes*. Should the decision be made to consolidate, integrate, or centralize health agencies within Harris County such as with HCPH and HHD, as an example, this office could oversee the integration process and help ensure that services are not disrupted for the community. As stated, it would also help monitor and evaluate multi-departmental initiatives that are designed to improve health outcomes in Harris County. As global health and domestic health are increasingly intertwined, such an office could facilitate incorporation of best practices from communities across the nation (and globe) with the notion that good ideas go beyond borders.

Serious consideration should be given to exploring the concept of centralizing or merging programs, service delivery pipelines, or even departments. Any such changes require thoughtful planning and methodical execution to ensure that service delivery is not disrupted. However, the potential gains from **streamlining and integrating care and prevention services across Harris County and the City of Houston** calls for serious consideration.



Section 2:

BUILDING RESILIENCE IN HARRIS COUNTY

Chapter 7: Health Equity

Chapter 8: Emergency Preparedness

Chapter 9: The Environment

Chapter 10: Mental and Behavioral Health





"We must commit to achieving health equity for all our communities by addressing the root causes if not morbidity and mortality will continue to rise."

—Dr. Octavio Martinez
Executive Director, Hogg Foundation For Mental Health

7

Health Equity

HCPH defines community resilience as a "community's capacity to prepare for, withstand, mitigate the effects of, and recover from public health emergencies, utilizing a health equity lens."[28] Harris County's diversity, economy and culture, bolstering schools, universities, industry, and innovative ideas, experiences, and shared determination for success and engagement has been a source of great strength and resilience for Harris County. Despite many strengths, many residents continue to be impacted by persistent health inequities that contribute to wide disparities between good and poor health across communities within Harris County. Resilience in Harris County requires a deep understanding of communities that experience consistently poor health outcomes and how deep and entangled the root causes of disproportionate disease and sickness burden are within different communities. Partners across the county and country agree that health is complex. Solutions are often multi-faceted, but any differences in good health across populations avoidable. This study offers insight into resilience by exploring health equity and disparities, emergency preparedness, environmental health, and mental health within Harris County.

To begin this conversation on health equity it is necessary to address and define health and health equity within Harris County.



Health Equity in Harris County

Health happens where you live, learn, work, worship, and play. In fact, zip code is a better predictor of health than one's genetic code. **The gravity of this fact is unmistakably felt when one realizes that neighbors who live 20 minutes apart could expect to live 20 years less.** In Harris County, the range of life expectancy is 23.4 years. Some residents have an average expected life expectancy of 89.1 years while others can expect to live 65.7 years (Figure 2.1). Some communities enjoy better access to parks, walkable sidewalks, secure family and social support, enhanced educational opportunities, access to fresh fruits and vegetables, and stable employment, all of which affirm the opportunity for good health. However, many face significant barriers to the opportunity of having the healthiest choice be the easiest choice. These social factors, often referred to as the social determinants of health (SDOH), are what influence either better or poorer health outcomes.

Figure 2.1 Harris County Life Expectancy

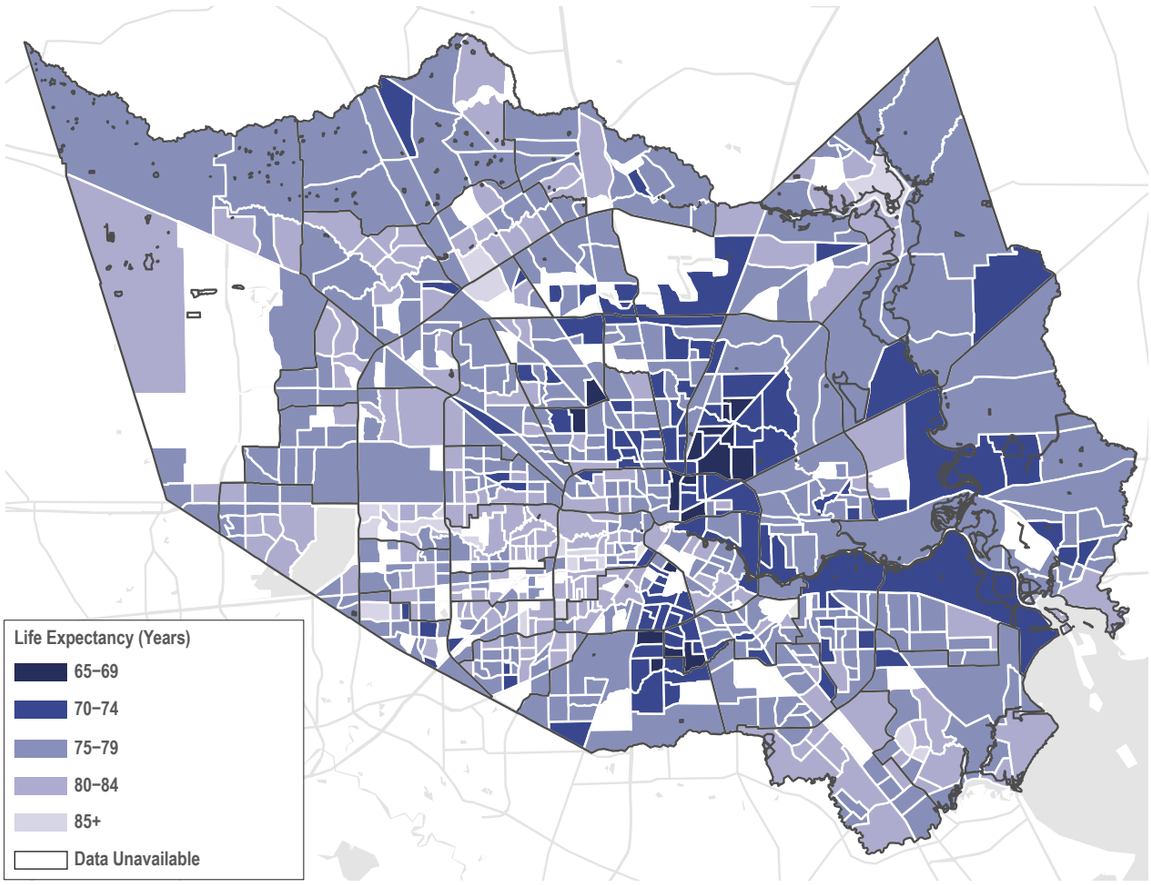




Figure 2.1 Life Expectancy by Census Tract and PUMA, Harris County, TX, 2010-2015.
Note: Each dot represents a census tract within each neighborhood.
Source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2010-2015.



Boston Public Health has a clear description of the differences between health disparities and health inequities:[164]

Health disparities *mean the same thing as health inequalities. They are simply differences in the presence of disease and health outcomes between population groups.*

Health inequities, *on the other hand, are differences in health that are not only unnecessary and avoidable but, in addition, are considered unfair and unjust. Health inequities are rooted in social injustices that make some populations more vulnerable to poor health than other groups.*

Good health is a product of multiple inputs including clinical care, public health, genetics, behaviors, policies, social factors, and environmental factors to name a few. But due to a variety of factors, often low-income families and neighborhoods, communities of color; children and older adults (particularly those who have experienced discriminatory practices based on race/ethnicity, religion, national origin, gender, and/or sexual orientation, etc.) are disproportionately impacted by health inequities that lead to poorer health and the burden of disease.[165,166] When some groups in our community encounter persistent health and social inequities, there are significant cost implications for the entire county as explored in the Business Case for Transforming Health.As Figure 2.2 shows, many communities across the country have opted to describe health inequities and the work necessary to overcome these remediable health outcomes. One strong such example is the BARHII framework. It alludes to the concept of work that is more "upstream" and work or consequences that would be considered more "downstream." In reality, it's not a linear "stream" as it is complex and circular river.

"...we must make a long term commitment to looking at the overall health of our community as... the most important determinant of our competitiveness in both economic and social success."

-Daniel Snare, President, American Leadership Forum



Locally, HCPH formally defines health equity as "the attainment of the highest possible standard of health for all people" in Harris County and as a process whereby HCPH works to ensure that individuals and communities have the optimal conditions to attain a healthy and productive life (Figure 2.3). In other words, health equity is both the destination and the journey. Health equity is achieved when all avoidable health differences among different groups are eliminated.

The case for advancing health equity is grounded in a moral imperative to protect the public's health and safety. And it's grounded in a more pragmatic one. In describing access to health care and transforming health, improving access alone cannot be the goal. **A health system with universal access but persistent health inequities is still a broken system.** In other words, the ultimate goal should be to make Harris County healthier. These population health outcomes are not measured in ratios of providers or distance and time, but rather in rates of disease, pollution, and unnecessarily premature death.[167] To make the mantra of making the healthiest choice the easiest choice, Harris County must tackle systematic differences in opportunities for health across communities and groups of residents. The pragmatism is that in the end, if a community does not address those factors that impact health for one population, it can impact other populations and certainly can lead to less than optimal overall community-wide health measures.

To understand health equity, it's important to know that **equity is not synonymous with equality** (sameness) for all. Rather, equity requires a community to identify the particular needs of residents and communities who face curable barriers to health. These barriers, which may appear as simple health disparities (differences) can be addressed through targeted solutions that focus on these particular community groups, populations, or geographic areas of a community. This last consideration furthers the notion that health happens where we live, learn, work, worship, and play.[168] This then requires increased, upstream collaboration and systems-level intervention crossing multiple institutions and sectors. These measures go beyond a strategy of equally spreading access to resources but rather highlighting where best those resources should be distributed.[169]

The pursuit of health equity requires intentional, focused, and sustained efforts to ensure that one's social status, identity, or other circumstances, such as race, gender, religion, national origin, level of income or education, neighborhood location/condition, etc. does not reduce or eliminate one's ability to be healthy or to access health-promoting resources. Everyone in a community can experience the opportunity for better health when health equity is a core doctrine of achieving health. Additionally, while this matters on a day-to-day basis, it is only when health equity is truly addressed that communities can be equally resilient to emergency and disaster.

Figure 2.2 A Public Framework for Reducing Health Inequities

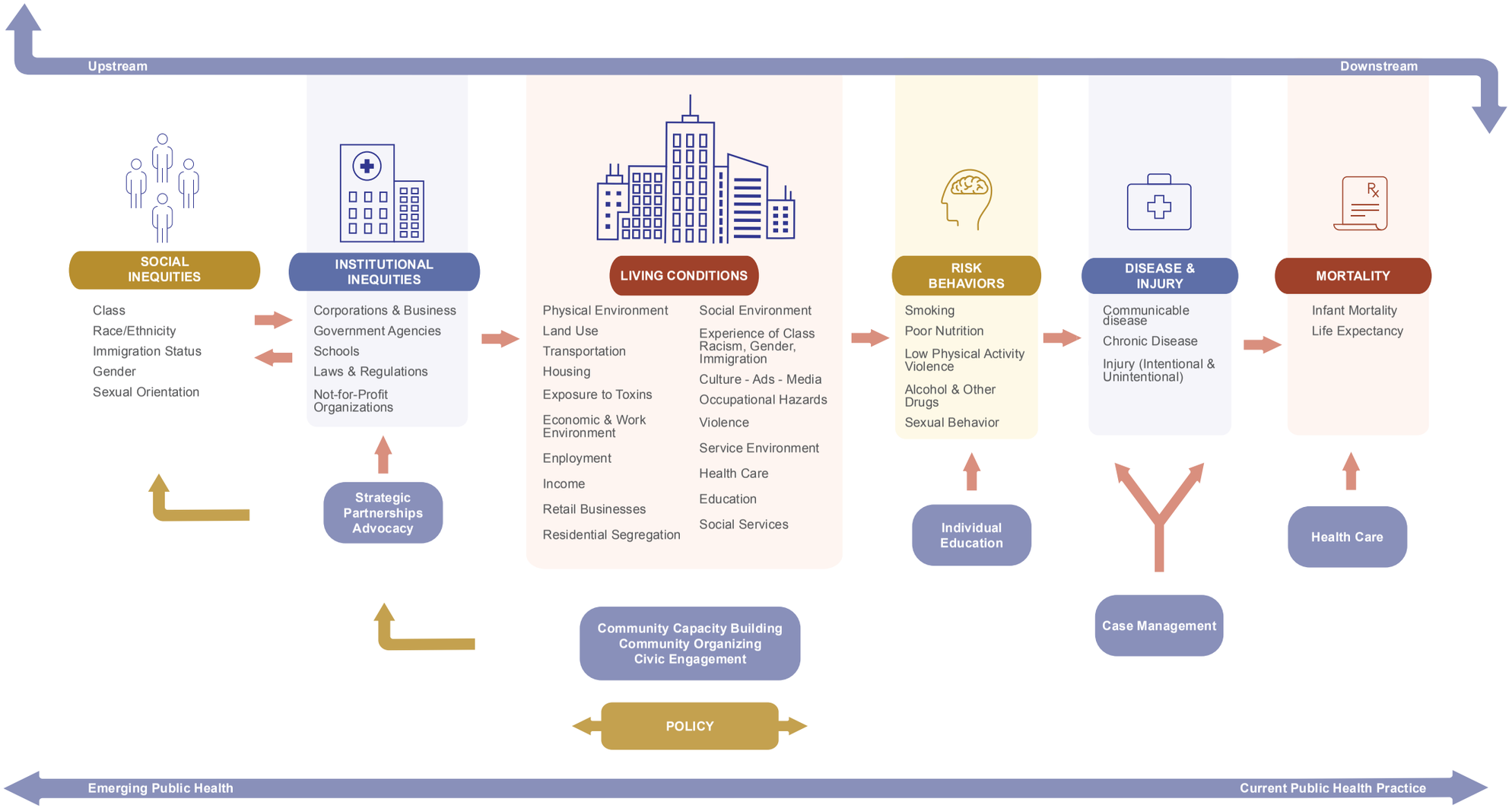


Figure 2.2 A Public Framework, for Reducing Health Inequities.
Source: Adapted from Bay Area Regional Health Inequities Initiative (2015).

Figure 2.3 HCPH Health Equity Framework

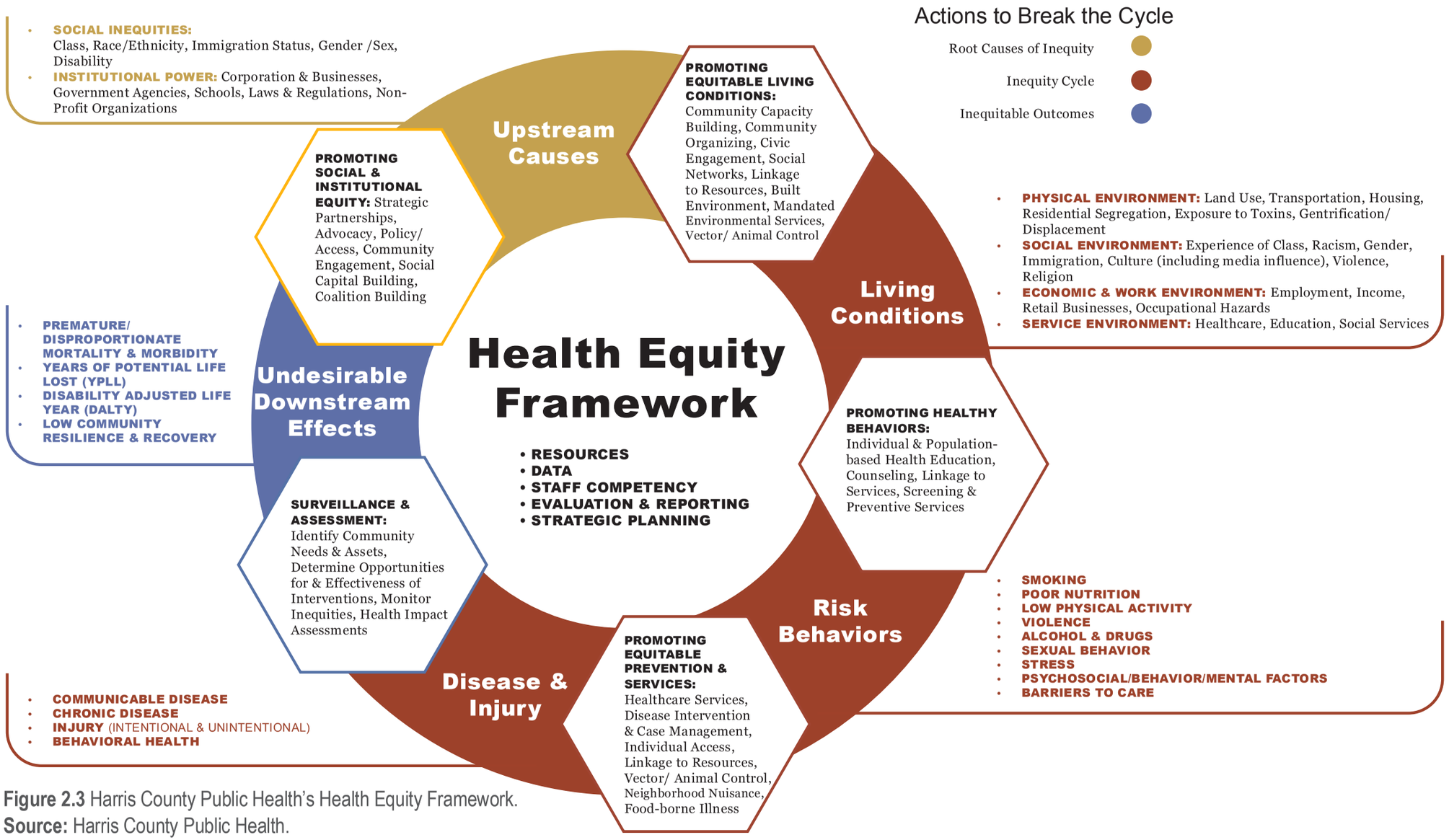


Figure 2.3 Harris County Public Health's Health Equity Framework.
Source: Harris County Public Health.

Snapshot of Health Equity in Harris County

The first step to addressing health inequity within Harris County is to listen to what residents regard as their health-related goals that they may have for themselves, their families, their neighborhoods, or their overall community. Equally, it leads to greater inclusivity and incorporates the sharing of data that organize private and public partnerships to address demonstrated inequities. To that end, this study references *The Talking Transitions: Survey Report*, a study completed in early 2019 at the early direction of newly elected Harris County Judge Lina Hidalgo. As part of the *Talking Transitions* concept, it was important to listen to what community members had to say about many issues in the Harris County community. While these ranged well beyond health, including community services, flood mitigation, education, crime, etc., many of these various issues have an impact on health. The following sections explore health disparity and inequity in Harris County using population level statistics and mapping of preparedness, resilience, and other health issues. In other words, this study compares the concerns of Harris County residents with available data as a basis for determining the recommendations.

In *Talking Transitions*, a number of important issues were brought forward by area residents. For example, residents living on the west side of I-45 reported that the air and water quality of their neighborhoods was "satisfactory" while residents living on the east side felt their current air and water quality was not. Respondents throughout Harris County indicated that they felt air and water quality were declining and over half of respondents thought county government should do more. Many respondents in Harris County reported their public transportation options were difficult. One-third of respondents had trouble paying for housing and many could not access quality jobs because of lack of training, networks, experience, and/or transportation.[170] As discussed below, these community concerns are validated with concrete data.

Air Quality

As mentioned above, *Talking Transitions* reports that residents living on the east side feel that their current air and water quality is not satisfactory.[171] Consistent with this sentiment, data obtained from EPA's National Air Toxics Assessment shows that cancer risk from toxic air throughout Harris County is higher in the east side of Harris County (Figure 2.4). Air toxics cancer risk estimates the lifetime cancer risk from inhaling air toxics and is shown as a rate of risk per lifetime per one million people.

Transportation

Talking Transitions indicates that public transportation options and options for walking and biking safely in most neighborhoods in Harris County were either poor or terrible.[172] This issue is compounded in households that have no vehicles available (Figure 2.5). This issue is echoed in Figures 2.6 and 2.7, it shows that the percentage of commuters that use public transit is substantially higher for Hispanics compared to non-Hispanic Whites, as well as for Blacks, Asians, and American Indians/Alaska Natives compared to Whites. This suggests that some racial/ethnic groups are disproportionately affected by these limited transportation options in Harris County and underscores the need for further investment in public transportation.

Figure 2.4 Cancer Risk from Inhalation of Air Toxics

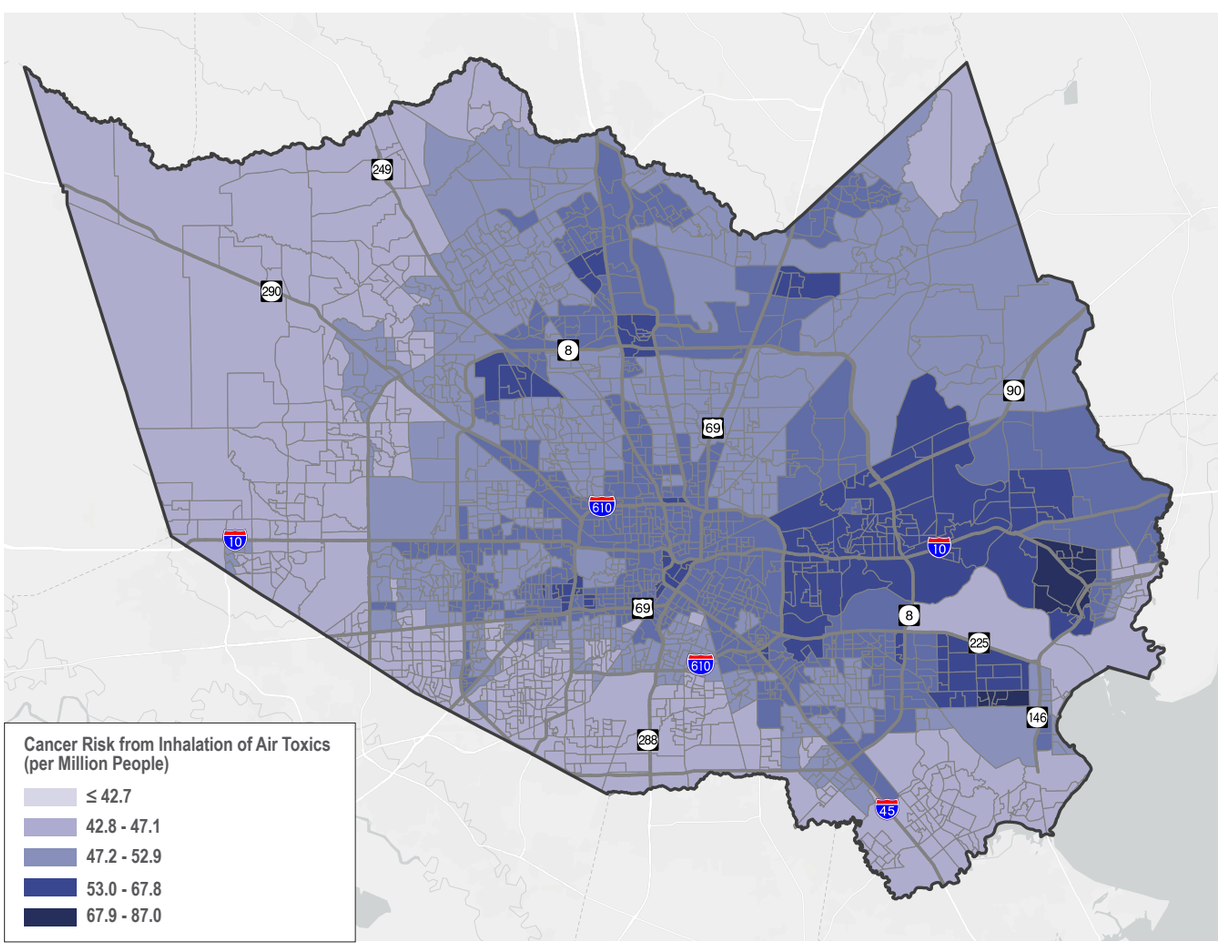


Figure 2.4 Cancer Risk from Inhalation of Air Toxics by Census Block, Harris County, TX, 2018.
Source: US Environmental Protection Agency, 2018.

Figure 2.5 Households with No Vehicles (%)

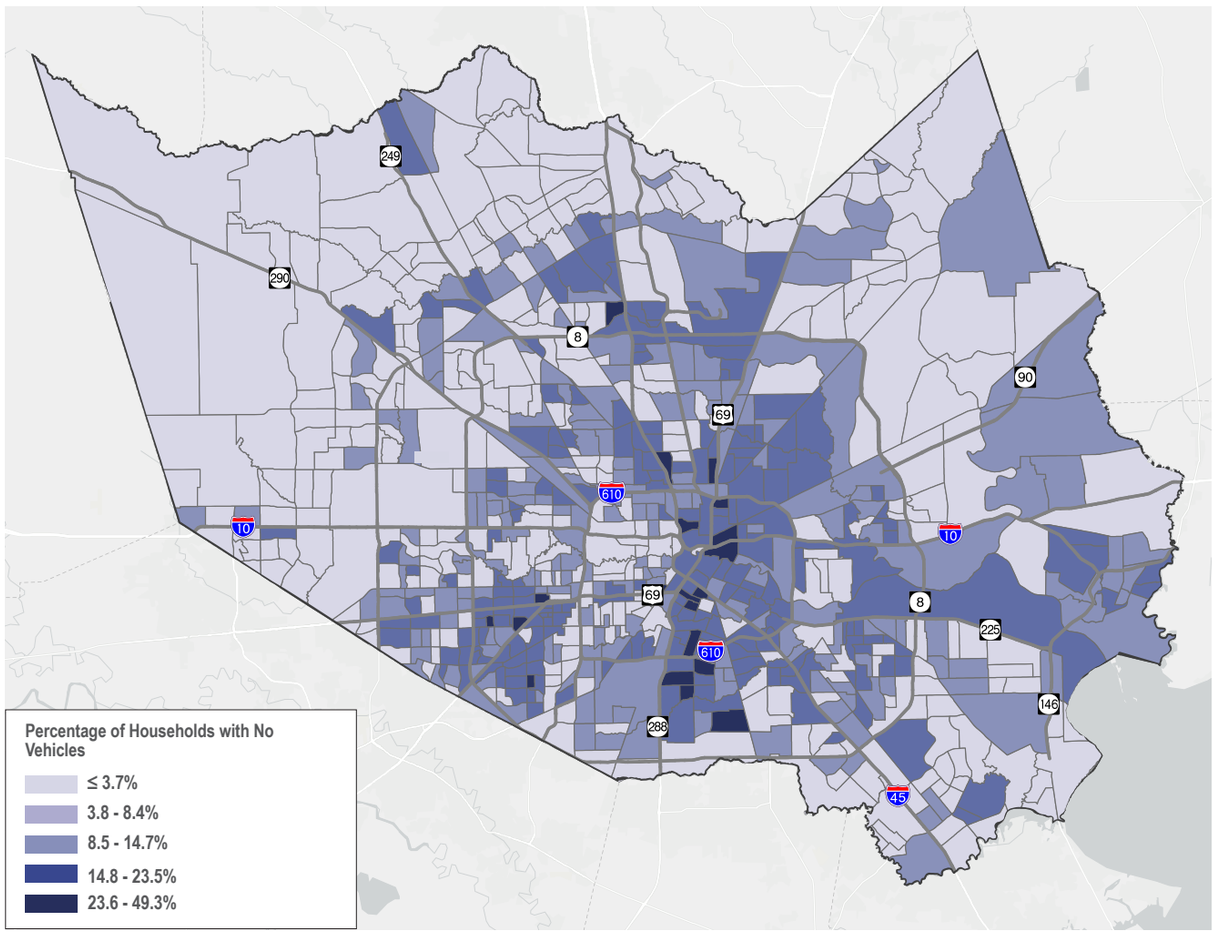


Figure 2.5 Percentage of Households with No Vehicles by Census Tract, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Figure 2.6 Use Public Transit by Race (%)

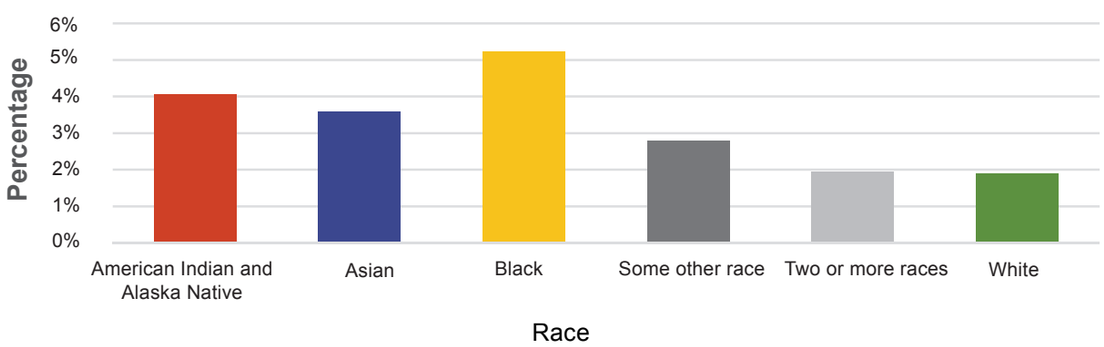


Figure 2.6 Percentage of Commuters That Use Public Transit by Race, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.



“...there are neighborhoods in Harris County that reflect that as many as 39% of its residents are uninsured.”

Figure 2.7 Use Public Transit by Ethnicity (%)

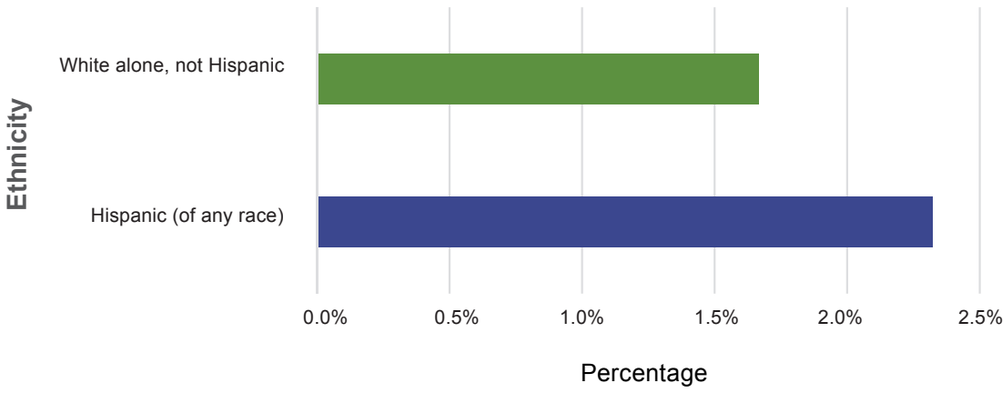


Figure 2.7 Percentage of Commuters That Use Public Transit by Ethnicity, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Figure 2.8 Evictions per Renter-Occupied Household

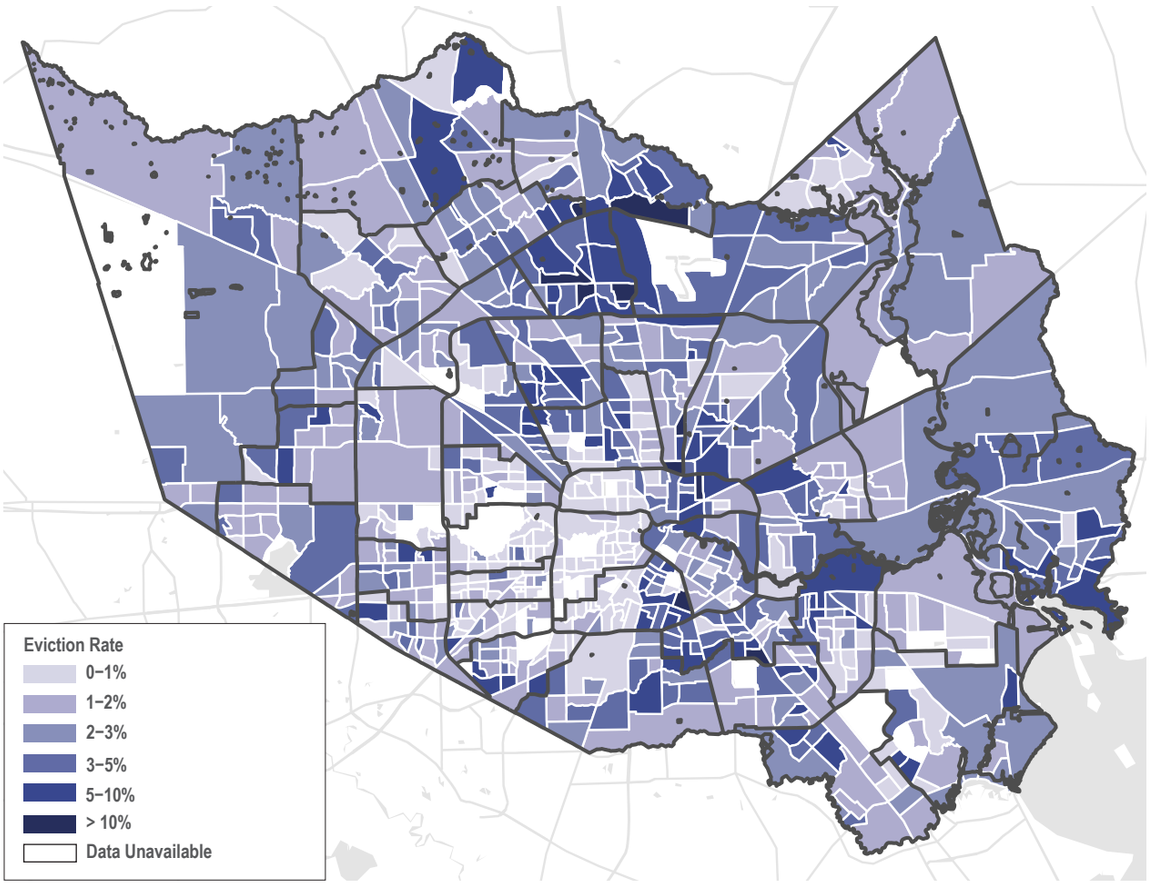




Figure 2.8 Number of Evictions per Renter-Occupied Household by Census Tract and PUMA, Harris County, TX, 2016.
Note: Each dot represents a census tract within each neighborhood; Eviction rate is homes that received an eviction judgment in which renters were ordered to leave, over the number of occupied renting households in each area.
Source: Eviction Lab, 2016.

Figure 2.9 Per Capita Income

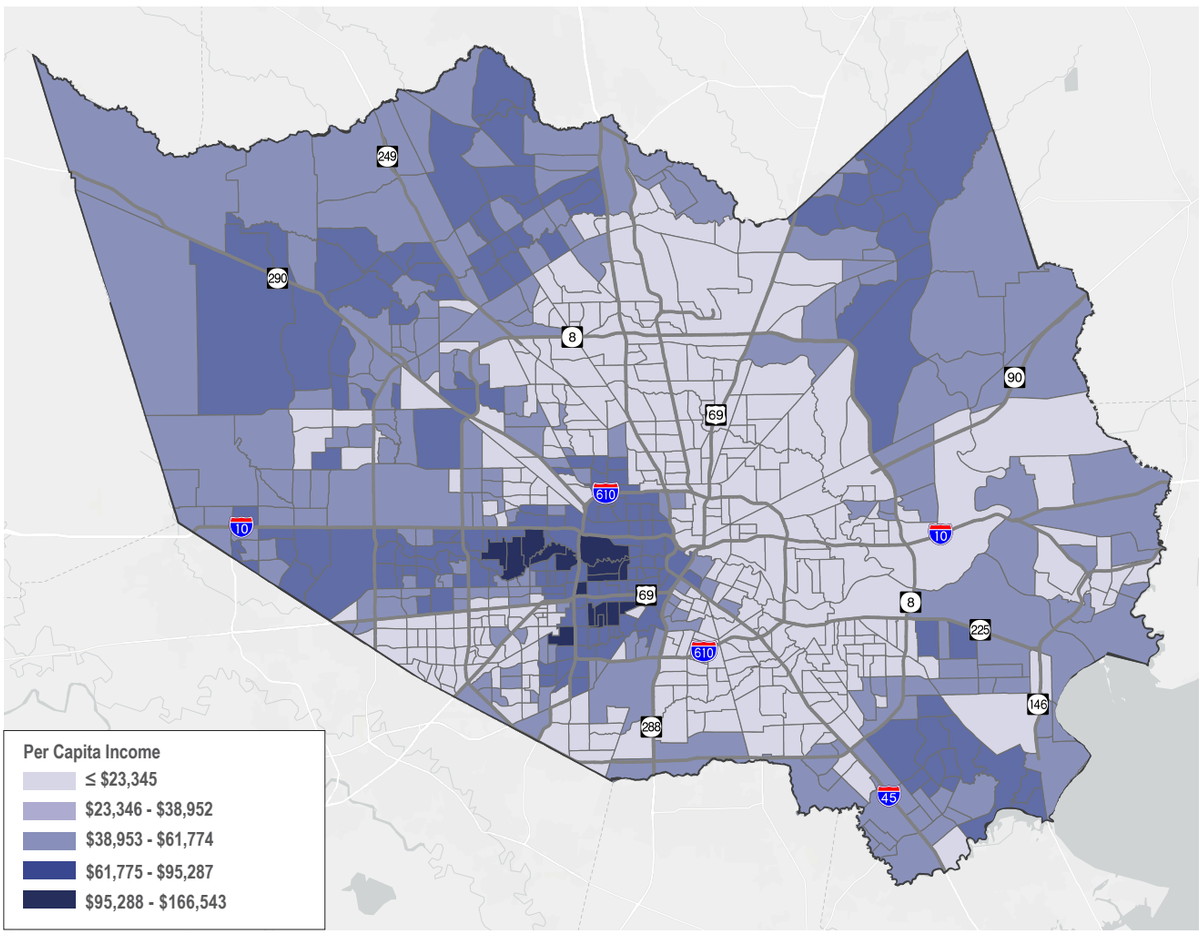


Figure 2.9 Per Capita Income by Census Tract, Harris County, TX, 2017.
Source: American Community Survey, US Census Bureau, 2013-2017.

Housing

According to *Talking Transitions*, 27% of respondents reported poor or terrible access to good homes, and 34% reported having problems paying for rent.[173] This community finding is similarly backed up in Figure 2.8, which shows the number of households that received an eviction judgment per renter-occupied households throughout Harris County. Champions and Greater Hobby-Edgebrook had the highest eviction rates.

Income

Figure 2.9 shows per capita income, or the mean income of all residents per census tract, for Harris County. Per capita income by census tract ranges from less than $23,345 per capita, all the way to $166,543 per capita. The inequities in income is reflected in resident's sentiment about availability of good jobs as reported in *Talking Transitions*.[174]

"It is very important that business and public leaders of our communities continue to identify and address those social determinants of health where different entities can have a meaningful impact in order to improve the health and the lives of those they serve."

—Dr. Robert Morrow, Southeast Texas Market President, Blue Cross Blue Shield of Texas

Health Care

The *Talking Transition* survey found that a substantial percentage of its respondents did not have health insurance.[175] In line with this, data from the ACS survey indicates that there are neighborhoods in Harris County that reflect that as many as 39% of its residents are uninsured (Figure 2.10). The *Talking Transition* survey also found that Harris County residents found health care to be unaffordable and inaccessible. Figures 2.11 and 2.12 illustrate that several areas in the county with high vulnerability and high population density are not within a 15-minute driving distance to trauma facilities. This may pose additional barriers to accessing health care.

Figure 2.10 People Without Health Insurance (%)

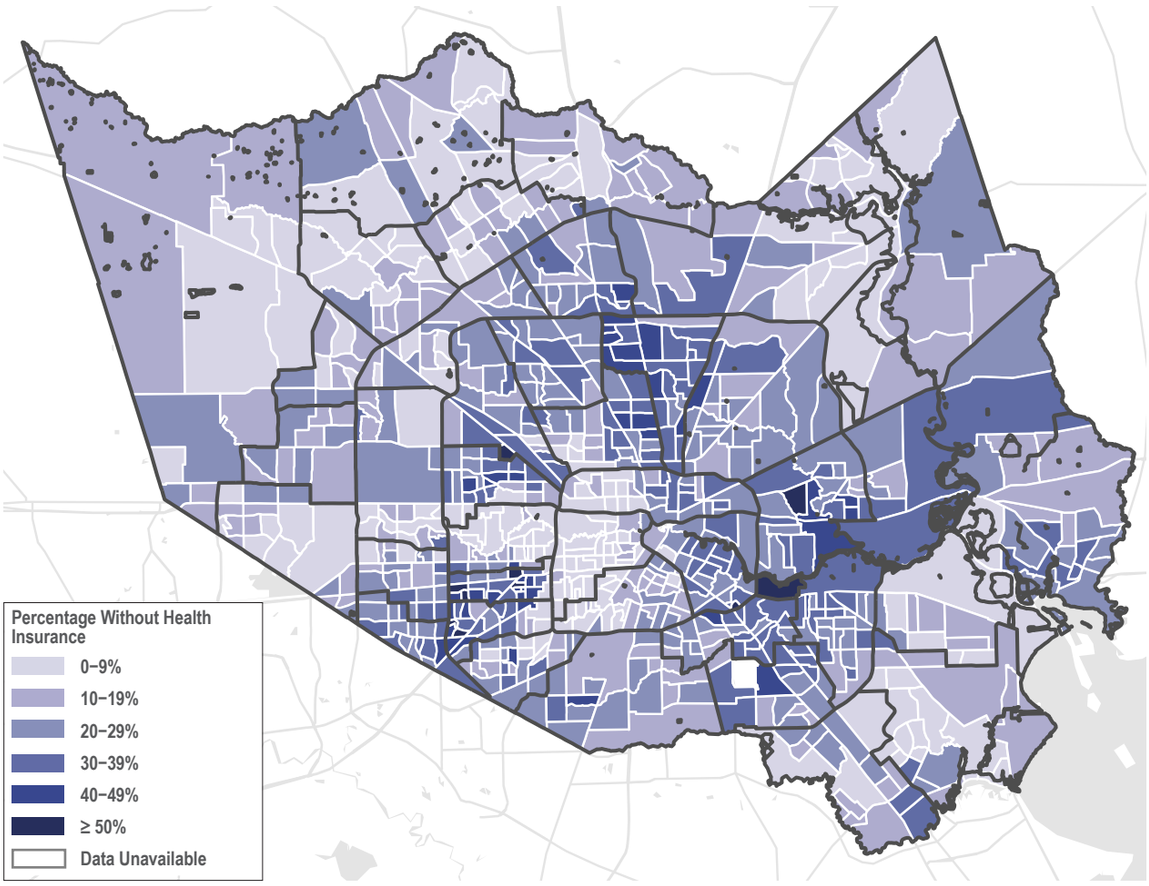




Figure 2.10 Percentage of People Without Health Insurance by Census Tract, Harris County, TX, 2017.
Note: Each dot represents a census tract within each neighborhood.
Source: American Community Survey, 2013–2017.



Figure 2.11 Driving Distance to Trauma Facilities and SVI

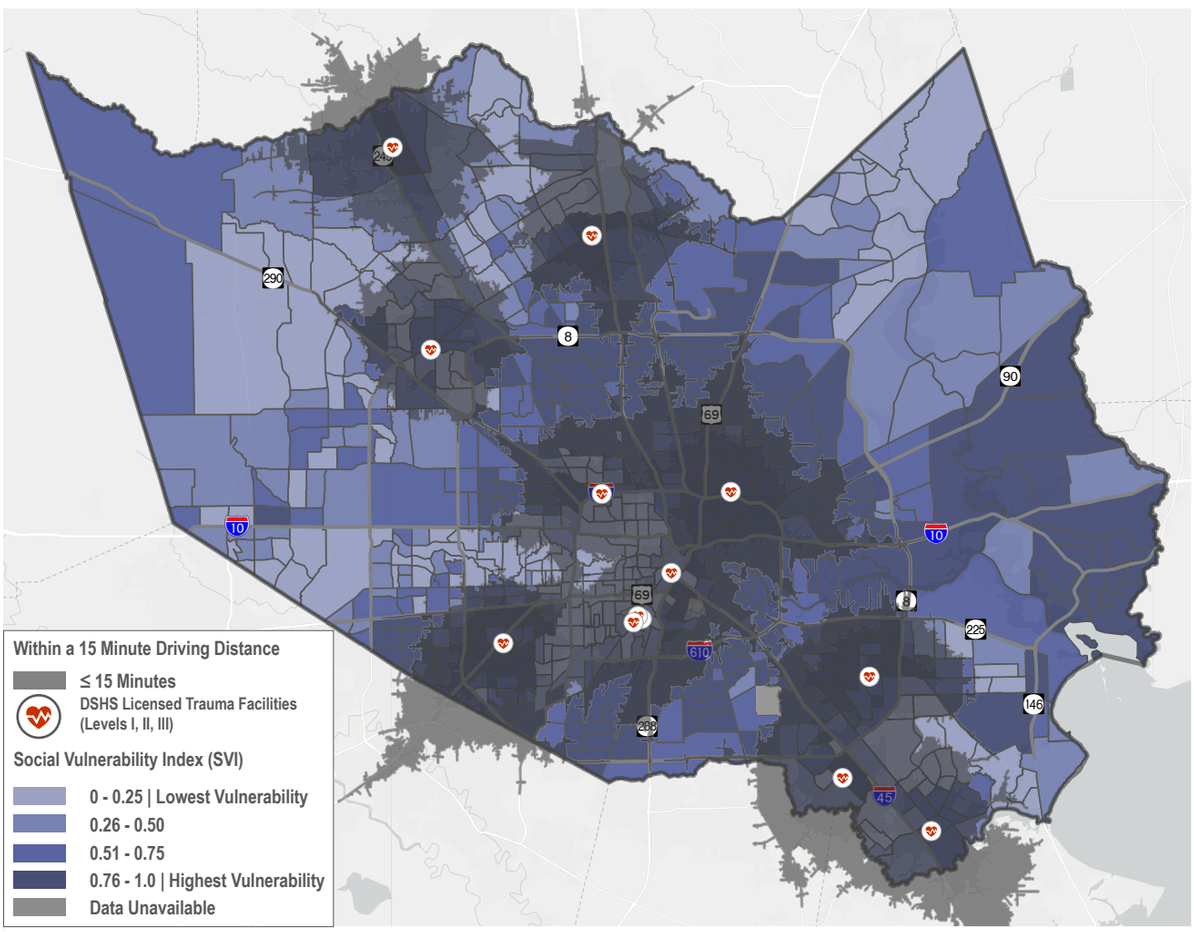


Figure 2.11 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Social Vulnerability Index, Harris County, TX, 2016.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Health Equity in Action

HCPH has ensured that one of its cornerstone values, equity, is built into personnel decisions and programming. This has included publishing various works on the importance of tending to the social determinants of health and equity while also building internal capacity for such work. A health equity coordinator position was created and now works hand-in-hand with resilience work internally to ensure strong collaboration across the system. Equally, equity work cannot be completed in isolation and the need to partner with stakeholders and community members to address SDOH was also recognized. This included the hosting of collaborative groups and convenings focused on both the SDOH and health equity. These collaboratives have already guided work to partner with other sectors and propose guidelines to screen for social determinants of health in clinical settings.[176]

Within the context of health care systems, there are also multi-payor federal and state initiatives with Medicaid to identify and address non-medical (social) needs of their patients. In 2016, CMS released an "Accountable Communities for Health" model to focus on connecting residents with referral and navigation services.[176]

"...there are neighborhoods in Harris County that reflect that as many as 39% of its residents are uninsured."

Figure 2.12 Driving Distance to Trauma Facilities and Population Density

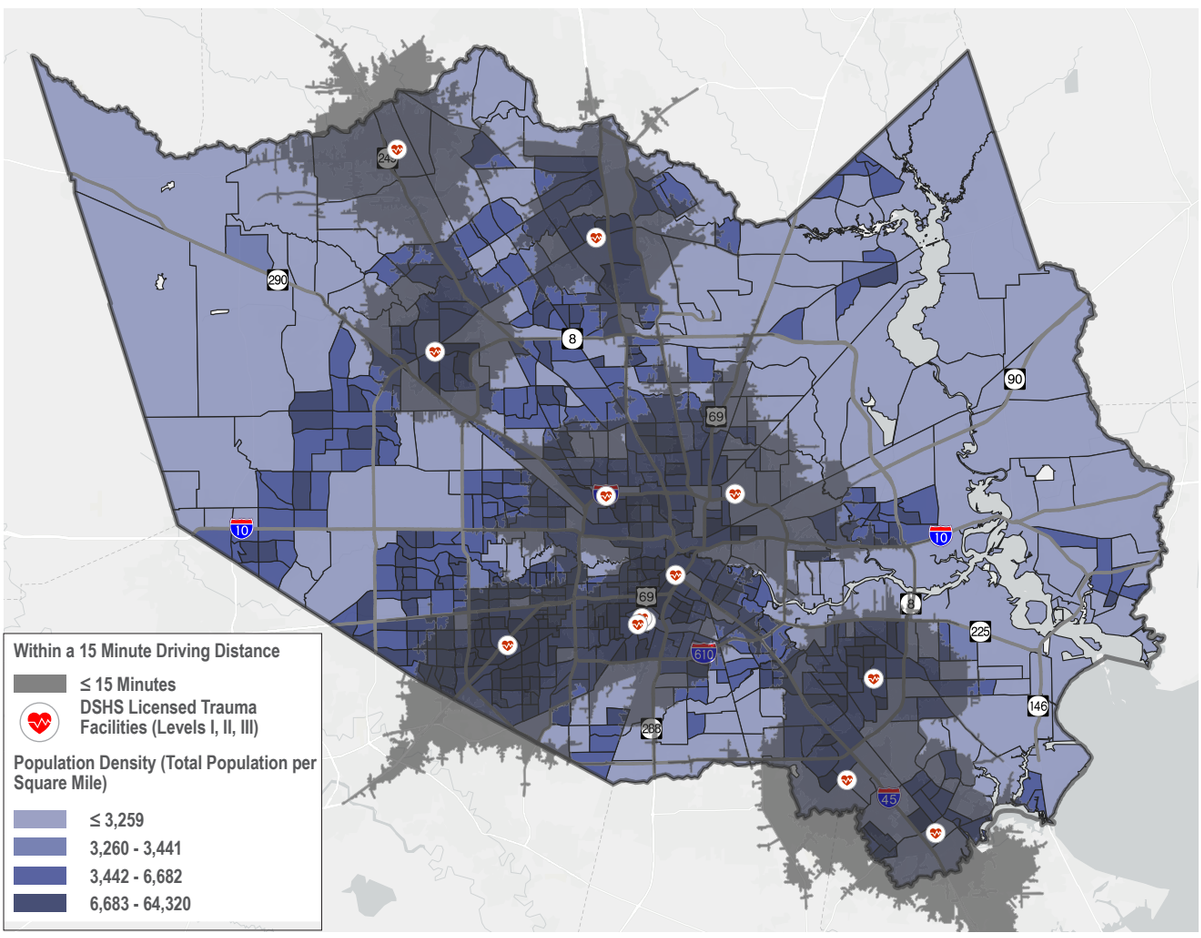


Figure 2.12 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Population Density, Harris County, TX, 2018.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018.

Conclusion

Health inequities are extremely important factors in a community's ill-health. Life expectancy maps can be viewed as a moral scorecard on health equity in a community. Those with lower expected lifespans need additional investment. By turning the corner on addressing health inequities and their inherent social elements, communities across the nation are seeing pathways for improving health for the overall community. There are numerous examples in Seattle/King County, San Diego County, Austin/ Travis County, Chicago/Cook County, Boston, to name a few. It is critical that the path to health equity is paved with community voice, community stakeholders and government and leadership stakeholders who all help create the vision for a healthy communities.



"According to *Talking Transitions*, 27% of respondents reported poor or terrible access to good homes..."



"Some residents have an average expected life expectancy of 89.1 years while others can expect to live 65.7 years..."



Health Equity

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 7 Recommendations

- Advance health equity as a shared value across all sectors, with a particular emphasis on county government, including consideration given to creating a “Chief Equity” champion role within county government incorporating national best practices.
- Promote robust engagement activities with communities who are disproportionately impacted to assure respect and inclusivity throughout various planning and implementation efforts.
- Improve systems for data collection, sharing and analysis across sectors with the goal of accurately capturing the health and social needs of all county residents, with a particular emphasis on those who are underrepresented.
- Develop and implement countywide equity training programs for all Harris County employees with a particular emphasis on social factors that may impact health.



"Health and well-being for a place as complex as Harris County requires a combination of good science and assessment but even more so deep engagement of community members with lived experience in the health problems we're trying to resolve."

-Dr. Alonzo Plough, Chief Science Officer and Vice President, Robert Wood Johnson Foundation


SHERIFF



“Emergency preparedness is a vital role of the public health and health care sectors… when residents are in their highest hour of distress and need.”

8

Emergency Preparedness

Harris County has seen its share of emergencies over the years. These include Tropical Storm Alison (2001), Hurricane Katrina (2005), Hurricane Ike (2008), and Hurricane Harvey (2017). These natural disasters are coupled by other public health emergencies such as the nation’s first BioWatch hit (2003), Harris County’s 18 month H1N1 influenza pandemic response (2009 - 2010), West Nile virus (WNV) response (2012), Ebola readiness and “response” activities (2014 - 2015), two rabies cases: the death of a resident and a rabies infected dog (2008 and 2015), Zika virus (2016-2017), a measles “resurgence” (2019), Tropical Storm Imelda (2019), and three large-scale chemical fires in 2019. It can be said that there is truly never a dull moment in Harris county. The eyes of the nation have watched the county be ravaged by disaster and have stared in awe at the resilience of Harris County residents and the unique expertise of public and private partners that the community boasts. Emergency preparedness is a vital role of the public health and health care sectors who also serve as part of the coordinated and community wide team of first responders when residents are in their highest hour of distress and need.



Introduction & Background

It is clear that emergencies occur repeatedly and unexpectedly, and Harris County must ensure that its communities are resilient and prepared for what hides behind the next corner. Emergencies are not equal opportunity events. They affect different groups in different ways. Some can easily anticipate and respond to hazard threats, others find it difficult, if not impossible.[178]

Following the attacks of September 11, 2001, emergency preparedness was brought to the national forefront. The Department of Homeland Security was established, which became the oversight agency to the Federal Emergency Management Agency (FEMA). In doing so, the National Response Framework and National Incident Management System (NIMS) was created to provide a common, nationwide approach to enable the whole community to work together to manage all threats and hazards. A key component of NIMS is the Incident Command System (ICS) which provides a structure for organizing response operations for a broad spectrum of incidents.

The Texas Department of Emergency Management (TDEM) coordinates emergency response activities for Texas. Similarly, for Harris County, the Harris County Office of Homeland Security and Emergency Management (HCOHSEM) is the agency responsible for coordinating countywide emergency response, identifying, preparing for, and mitigating hazards, and managing the recovery from emergency situations that affect Harris County. HCOHSEM works with other response partners and stakeholders including the City of Houston and the other 33 cities within Harris County. It is the lead agency responsible for coordinating countywide emergency response, mitigation, preparedness, response, and recovery.

The director of HCOHSEM is Harris County Judge Lina Hidalgo. She oversees the coordination of planning and response activities across Harris County in accordance with the Emergency Management Coordinator and their team. The *Harris County Basic Plan*, which has 23 Annexes (A-W), details its approach to emergency operations, and is applicable to Harris County government including all local officials, departments, agencies, cities, and emergency service districts. Harris County and all cities within Harris County have adopted the NIMS in accordance with the federal government's Homeland Security directives.[179]



Public Health Emergency Preparedness

According to the federal Office of the Assistant Secretary of Preparedness and Response (ASPR), Public Health Emergency Preparedness (PHEP) has been defined as "the capability of the public health and health care systems, communities, and individuals to prevent, protect against, quickly respond to, and recover from health emergencies, particularly those whose scale, timing, or unpredictability threatens to overwhelm routine capabilities. Preparedness involves a coordinated and continuous process of planning and implementation that relies on measuring performance and taking corrective action."

CDC manages the Public Health Emergency Preparedness (PHEP) cooperative agreement. This grant is a critical source of funding for state, local, and territorial public health departments. In Emergency Preparedness Funding-FY2019 the state of Texas received a total of $39,141,025 in PHEP funds. This funding requires all state and local recipients to advance jurisdictional public health preparedness and response capacity through 15 PHEP capabilities. It should be noted that there has been a significant decrease in CDC funding for PHEP nationally and to Texas since the initial funding allocation in the aftermath of the "9/11" attacks in 2001. DSHS is the lead entity responsible for planning and coordinating public health and medical responses within the state under the direction of TDEM. PHEP funding in Texas flows from CDC to DSHS and then to local communities. However, since all emergencies occur locally, it is no surprise that local health departments within Texas are responsible for public health and medical responses within their own jurisdictions (if an LHD does not exist, then regional offices of DSHS take on this role). Similarly, Texas statute requires each jurisdiction also to have a Local Health Authority (LHA). The LHA should be a physician that is appointed by the governing body in that jurisdiction (whether county or city) to oversee the health and medical aspects of emergencies within the jurisdiction.[180] The HCPH Executive Director as a physician serves in the capacity of the LHA for Harris County. If a jurisdiction chooses not to have a designated LHA, then the regional office of DSHS takes on this role.

Broadly speaking, Harris County strives to protect residents in the event of a variety of health emergencies including bioterrorism, infectious disease outbreaks, and other natural and man-made disasters. This is done through community outreach, planning, training and exercises, and through the creation and adherence to the Harris County Basic Plan.

Public Health Emergency Response

HCPH is the lead coordinating agency for *Harris County's Basic Plan – Annex H: Health and Medical* is the primary agency responsible for protecting the public's health in the event of a widespread public health emergency within Harris County. As part of the *Basic Plan*, HCPH's Office of Public Health Emergency Preparedness and Response coordinates health care systems, communities, and individuals to respond to public health emergencies. When required and depending on the nature of the emergency, the role within HCPH emergency response potentially includes the following responsibilities:

- Establishment of health and medical command and control
- Maintain situational awareness
- Conduct disease surveillance in communities and hospitals
- Provide vaccinations, prophylaxis (action taken to prevent disease) medications, and conduct health screenings
- Conduct shelter assessments (epidemiological, medical, and environmental)
- Ensure food and water safety
- Conduct mosquito surveillance and testing
- Coordinate animal health and safety
- Create and provide health-related risk communications
- Coordinate with health and medical partners: IFS, Southeast Texas Regional Advisory Council (SETRAC), Harris Center, Harris Health, etc).

"I understand the public health role has to provide for...gaps, but in an ideal world it would not need to. The world's upside down."

-Harris County Stakeholder

The City of Houston also operates in a similar fashion with its own emergency management structure that includes HHD as the lead agency responsible for health and medical emergency responses within the city.

Community Resilience

In addition to public health response roles, public health also leads, or is heavily involved in, recovery activities long after a major disaster, such as long-term health and disease surveillance monitoring, public messaging on the potential physical and mental health effects of the disaster and how to mitigate them, etc. Before a disaster even begins, however, attention to building community resilience is of extreme importance.

Strengthening a community's level of physical, behavioral, social, and environmental health and well-being is crucial to disaster preparedness because a healthier population can contribute to a stronger community, and these communities are then better able to withstand and recover from disasters. In addition, a stronger recovery influences the future well-being of those very individuals and communities. All of this contributes overall to a more resilient county.

HCPH defines community resilience as a "community's capacity to prepare for, withstand, mitigate the effects of, and recover from public health emergencies, utilizing a health equity perspective." In 2016, HCPH pioneered a first-of-its kind position of a Community Resilience Officer (CRO) to lead its efforts in promoting community resilience for the residents of Harris County. The CRO's main priorities are to build capacity and networks with the diverse communities within Harris County that allow for a deeper understanding, trust, and interconnectedness in advance of an emergency which can then be leveraged during and after the emergency. Activities include building community partnerships and engagement, first responder resilience, and community health resilience integration. With attention to the work in resilience, coupled with health equity work as referenced previously, health departments can play an integral part in working on deeper community issues when there is no emergency as well as when an emergency strikes. Given the multitude of emergencies that Harris County has faced over the years, this is especially important in a repeatedly impacted community.

Social vulnerability refers to the resilience of communities and their ability to withstand external stressors that adversely impact human health such as natural or human-caused disasters or disease outbreaks.[181] Figure 2.13 shows that several areas in Harris County have high social vulnerability, meaning that they are more susceptible to, and less prepared for, emergencies.

Figure 2.13 Social Vulnerability Index

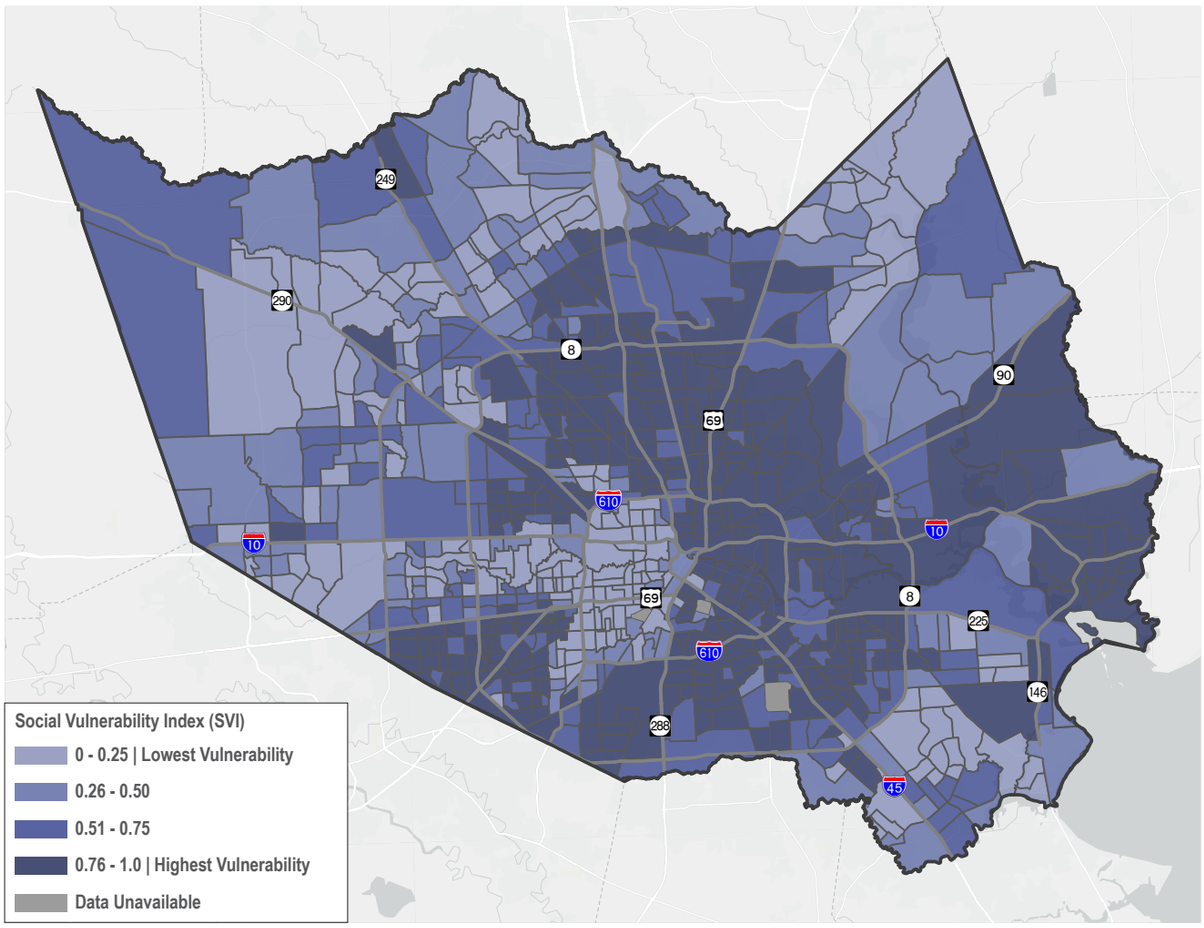


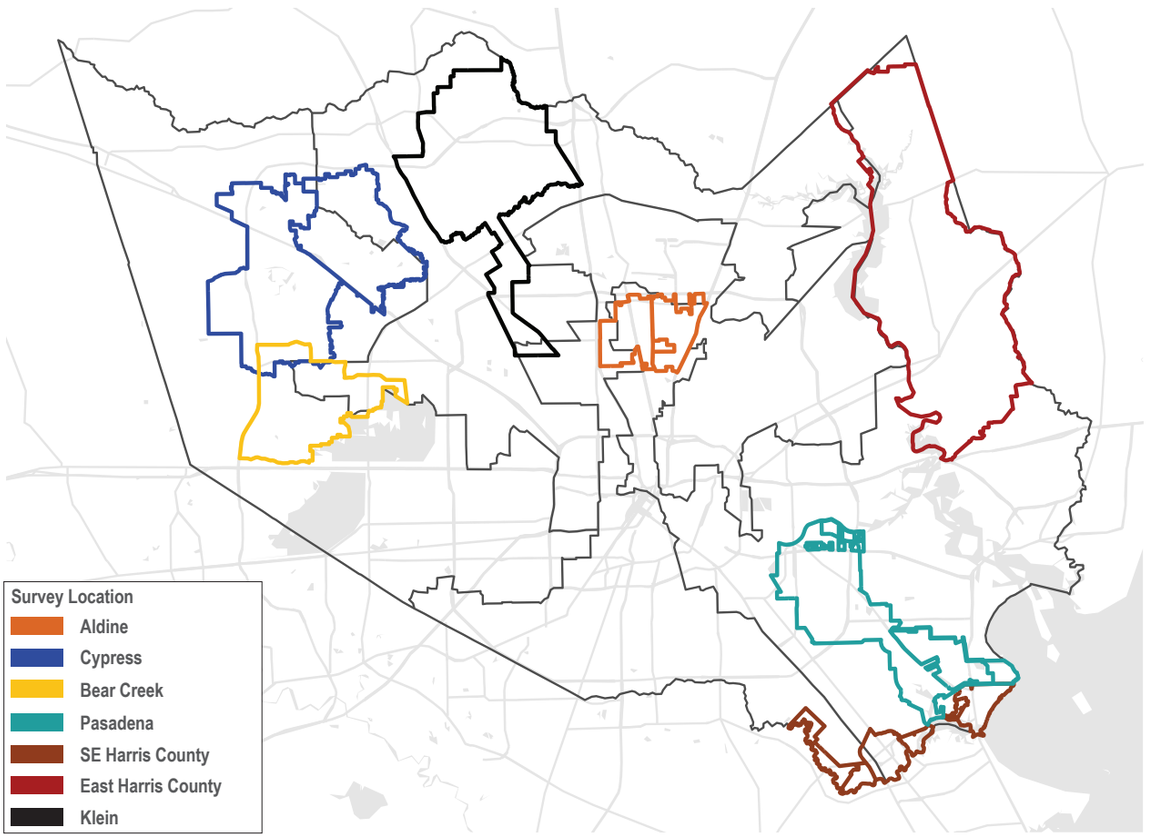
Figure 2.13 Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
Source: Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

The Community Assessment for Public Health Emergency Response

The Community Assessment for Public Health Emergency Response (CASPER) is a nationally recognized tool that can be used to understand and enhance a community's resilience. HCPH leads a yearly CASPER survey that assesses a community's level of preparedness while also determining the level of resilience by measuring social cohesion and mental health. The results help determine specific community needs on resilience/preparedness trainings, tools, and resources. A CASPER survey may also be carried out directly after a disaster or during the recovery process in the years following a major catastrophe, like after Hurricane Harvey. In fact, HCPH has been conducting multiple CASPER surveys throughout Harris County since 2015 to underscore the needs of the community by knocking on doors and interacting with residents on a one-to-one basis. These surveys offer important data on the immediate and long-term needs of different communities following the disaster and they inform HCPH and partners on the community's recovery progress, which can also better guide resilience and preparedness work.

For example, Figure 2.14 indicates how prepared CASPER respondents (households) across Harris County handle an emergency before a disaster, during disaster response, and throughout disaster recovery. This figure shows that there is still more work to be done in preparing Harris County residents before a disaster through health education, enhanced communications with individuals and communities, and an increased presence in communities through mobile health villages and other departmental activities, among others.

Figure 2.14 Household Preparedness



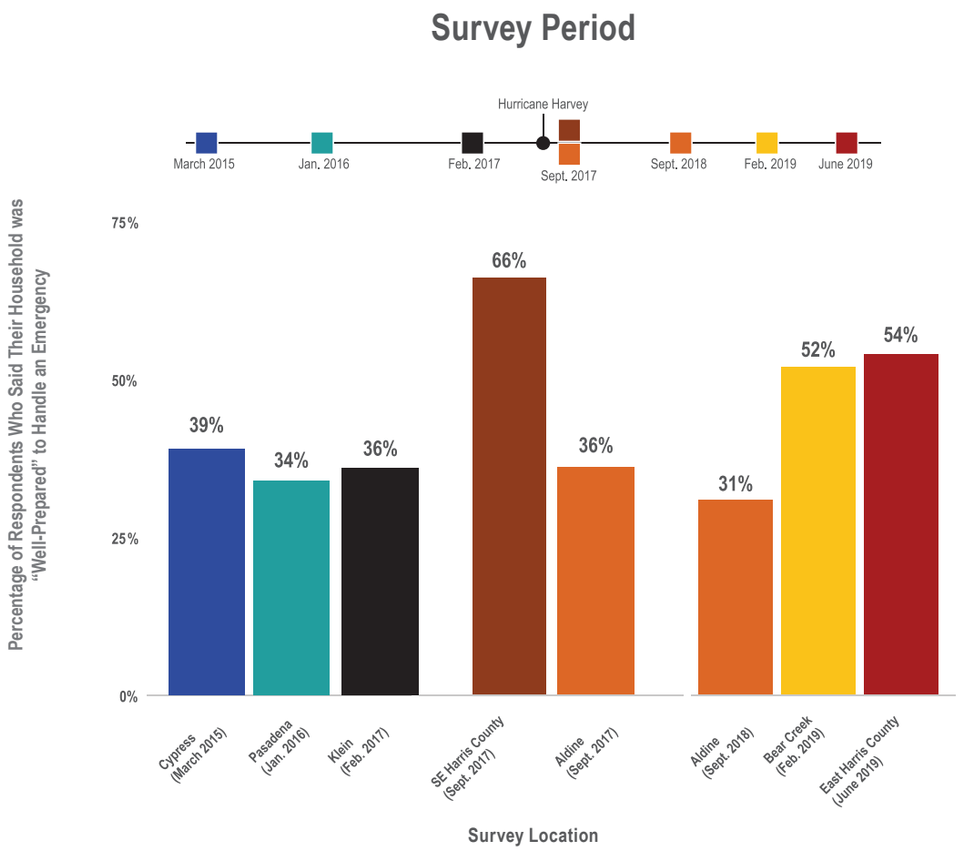


Figure 2.14 Percentage of Persons Who Consider Their Households "Well-Prepared" to Handle an Emergency, Harris County, TX, 03/2015-06/2019.
Source: CASPER Community Survey, Harris County Public Health, 2015-2019.

Hospital Preparedness Program

In coordination with the PHEP program, ASPR's Hospital Preparedness Program (HPP) supports regional collaboration, health care preparedness, and enables the health care delivery system to save lives during emergencies and disaster events that exceed the day-to-day capacity and capability of existing health and emergency response systems. The cornerstone of the HPP is development of health care coalitions that incentivize diverse and often competitive health care organizations with differing priorities and objectives to work together. HPP is the only source of federal funding for health care delivery system readiness, intended to improve patient outcomes, minimize the need for federal and supplemental state resources during emergencies, and enable rapid recovery.

The DSHS HPP works with the 22 statewide trauma service area (TSA) regions to develop and implement health care coalitions (HCCs). From 2009 to 2018 HPP funding for Texas decreased from $26 million to $16 million a 48% reduction.[182] Despite this decline, this funding requires HCCs to increase regional health care preparedness and response capacity.[183] It should be recognized that while PHEP funding helps increase preparedness and response capacity in local health departments, HPP funding helps increase capacity in the health care system, particularly within hospitals. The federal intent is for both funding streams to work together in a complementary manner on behalf of local communities.[184]

For Harris County and 24 additional counties, SETRAC is the state HPP contract recipient, and it coordinates the HCC in this area called the Regional Healthcare Preparedness Coalition (RHPC).[185] RHPC is the multidisciplinary preparedness committee of SETRAC committed to providing collaborative planning and response to emergencies and to preserve the medical infrastructure of the region. Local health departments work closely with health care partners and SETRAC to ensure coordination of health care delivery during emergencies. Of note, the SETRAC has been nationally recognized owing to both its importance to regional planning and response but also due to how well it executes on its mission objectives despite the countless number of responses it has responded to over the years.

SETRAC also oversees the Catastrophic Medical Operations Center (CMOC) and its operations during emergencies. The CMOC serves as a coordinating response entity for health care agencies within the region (25 counties in three TSAs) and is designed to coordinate medical care, patient evacuation, and medical resources throughout the region prior to or following a large-scale incident. Using a

Figure 2.15 Distance to Hospitals

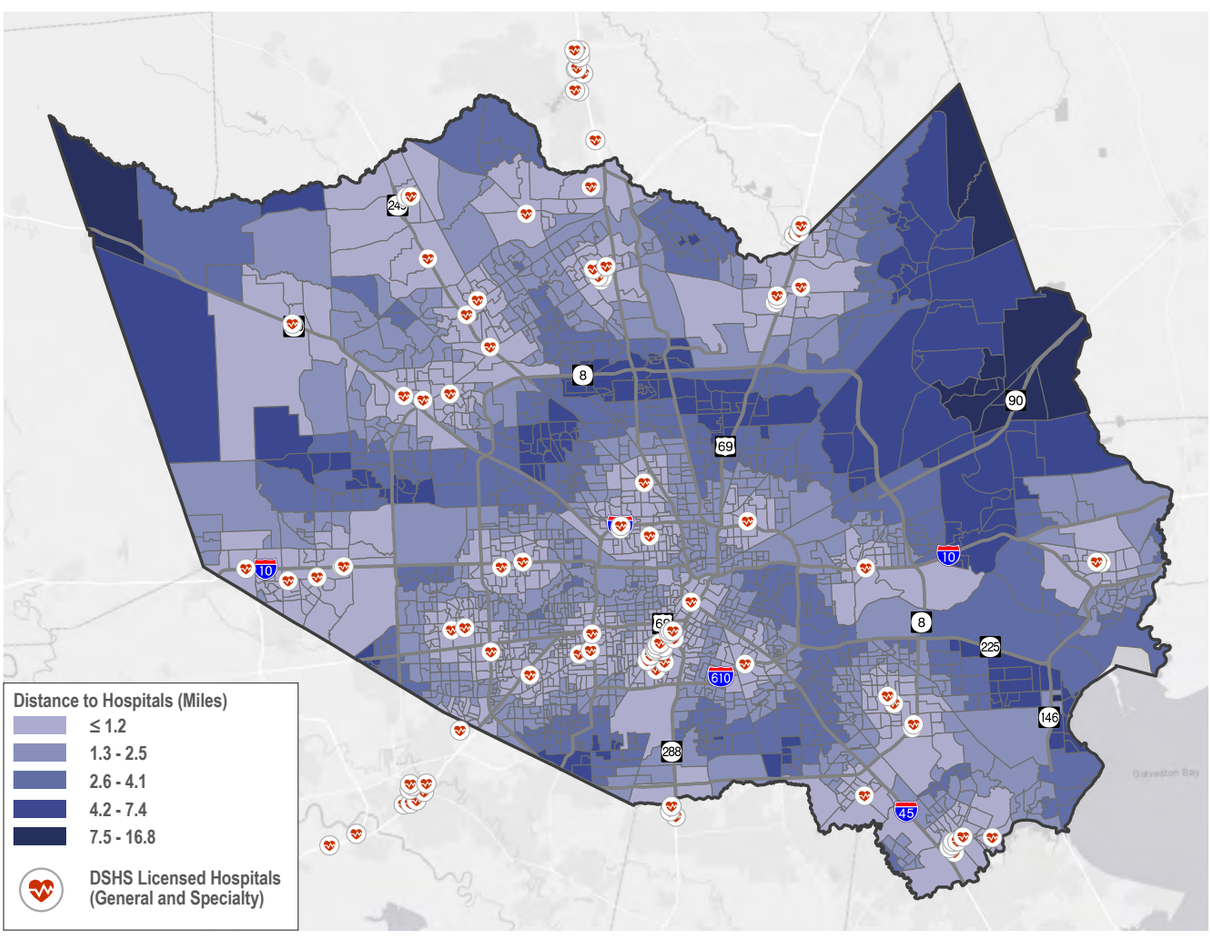


Figure 2.15 Distance to DSHS Licensed Hospitals by Census Block, Harris County, TX, 2019.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019.



multidisciplinary approach, the CMOC coordinates medical response and resource requests for over 180 hospitals and 900 nursing homes serving an area of 25 counties with more than 7.7 million residents. Residing within this 25-county region is also 28% of the state's self-reported disability population.

During an emergency or to create additional surge capacity within any medical system, the CMOC coordinates the redistribution of medical care and resources within the region. The placement of individuals into health care facilities is determined based on hospital capacity and on medical capability matched with the health care needs of patients. Long-term care agencies and specialty hospitals are included in the surge capacity decision-making. The CMOC approach helps keep acute care agencies from becoming overwhelmed with non-acute patients. The most medically fragile individuals are treated in the most appropriate agency, eliminating the need for further transfer of a patient for appropriate or specialized care.

SETRAC maintains and utilizes two electronic platforms for sharing health care and patient tracking information across the region, *EMResource* and *EMTrack*. *EMResource* is a web-based communications resource management system designed to address resource management needs across the health care consortium. It may be utilized daily for updated information or in any urgent health care situation such as in the event of a mass casualty. *EMTrack* is a HIPAA compliant system that allows for the tracking of people, pets, or populations throughout incidents. *EMTrack* allows EMS agencies to notify hospitals of inbound patients to allow them to proactively plan for patient arrival.EMS decisions on where to transport patients are based upon patient medical need and upon standing EMS protocols for transport locations. For example, EMS providers consider the patient condition and capacity status of the hospital when transporting. Hospitals that list their status as "saturated" in *EMResource* indicate that the hospital has reached, or is above, patient capacity and the EMS crew may be delayed off-loading the patient, resulting in delayed return to service times. Patient care can also be affected due to patient surge, outpacing staff and resources at the facility. Regarding EMS protocols, transport locations may include hospitals with specialized pediatric, cardiac, stroke, percutaneous coronary intervention, trauma centers, orthopedic, or neurosurgery availability.

Hospitals During Disasters

Due to the large amount of hospitals in the Greater Houston area (see Figures 2.15, 2.16), and the fact that hospital systems have multiple footprints around the area, there is a large pool of staff that the hospitals may draw from in a disaster. This is especially true for an internal hospital disaster (within the confines of the hospital). It may be due to power or water failure, fires, or bomb scares, among others. To provide situational awareness to EMS agencies and other health care partners, hospitals that are experiencing an internal disaster indicate this status on *EMResource*.

Figure 2.16 Distance to Trauma Facilities

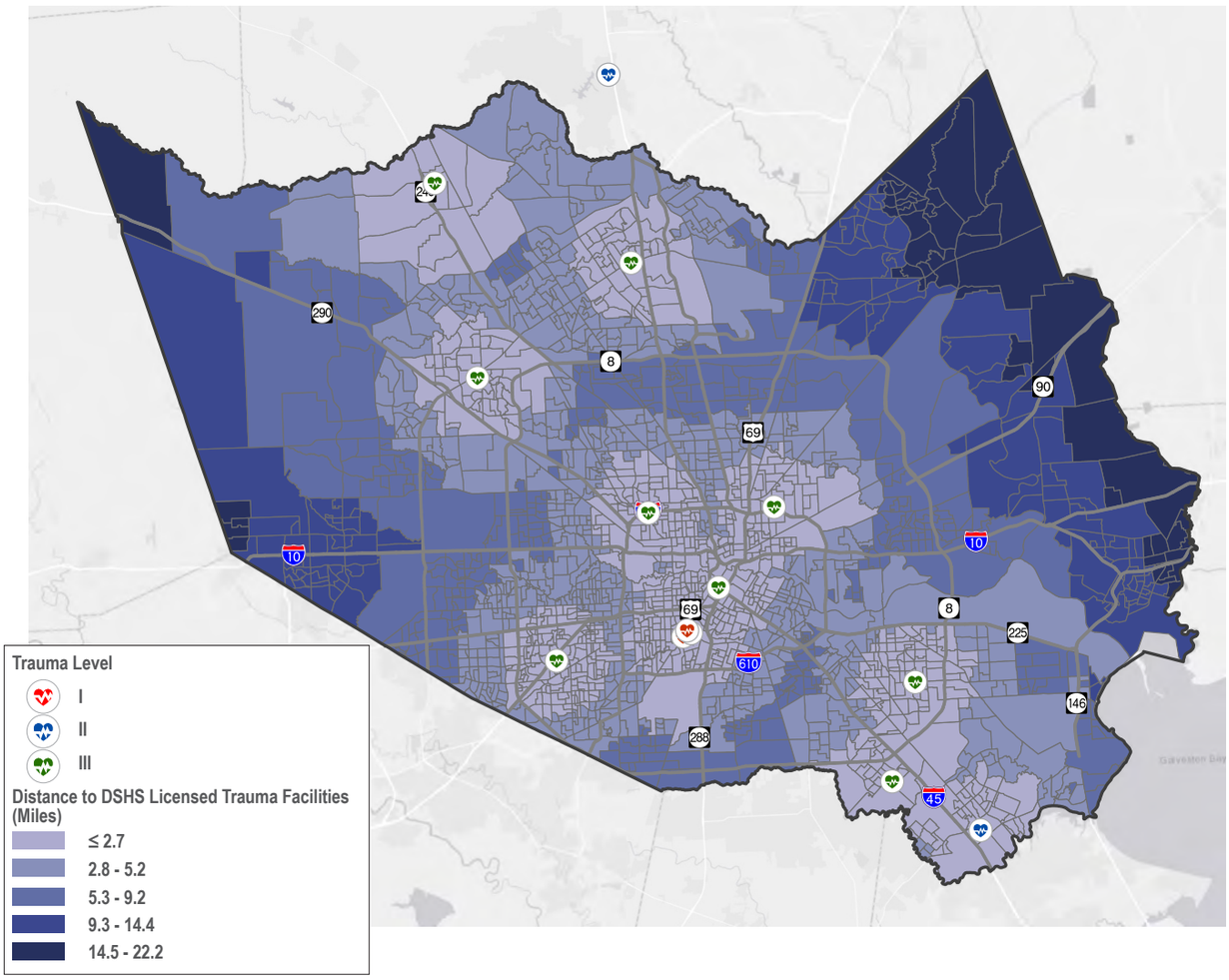


Figure 2.16 Distance to DSHS Licensed Trauma Facilities (Levels I, II, III) by Census Block, Harris County, TX, 2018.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2018.

During periods of internal hospital disasters, EMS agencies are not permitted to transport patients to those affected facilities. For example, HCA Healthcare can pull resources from around the country to staff the hospital(s) experiencing an internal disaster, and move patients to other hospitals within their system, to provide continued care. Some systems including Houston Methodist, Texas Children's Hospital, CHI St. Luke's, Harris Health, and Memorial Hermann are also able to move patients to their other hospitals if one or more hospital may be affected from an internal disaster. The patients are moved using their fleet of private ambulance providers that they contract with daily as well as air assets when needed. Harris Health maintains their own fleet of ambulances to provide the same transport capabilities.

CMOC is also a state resource available for all the area hospitals, dialysis centers, and long-term care centers when they need to coordinate evacuation resources and bed availability in other locations to move patients. In addition to operating CMOC, SETRAC also coordinates the state asset Emergency Medical Task Force 6 (EMTF 6) which, among other things, deploys ambulance buses (AMBUSes) to move patients in a disaster. There are three AMBUSes in the EMTF Region 6 which are housed and operated by the Atascocita Fire Department, Fort Bend EMS, and the Houston Fire Department.

The EMTF is a state and federally (DSHS and Office of the Assistant Secretary for Preparedness and Response (ASPR)) funded program with the mission of creating state-deployable medical teams, regionalized for rapid mobilization and readiness. The goal of the EMTF program is to provide a well-coordinated response, offering rapid professional medical assistance to emergency operation systems during large scale incidents. In addition to AMBUSes, immediately available resources include Mobile Medical Units (MMUs), ambulance strike teams (hundreds of units across Texas), Registered Nurse (RN) strike teams, Medical Incident Support Teams (MISTs) and Staging Managers. Mobile communication trailers are also deployed to provide for radio interoperability when multiple agencies are present. The Texas EMTF is part of the Texas Disaster Medical System.

"We view local public health departments as leaders that should step out and provide guidance to the health care community, especially in times of emergency."

-Dr. James Hoyle, Medical Director of Clinical Operations, Kelsey-Seybold

Disaster Relief Shelters

Disaster relief shelters are often opened in response to natural or man-made disasters to provide residents with immediate and short-term accommodations to help them recover from the trauma of the disaster, as well as provide a base to start the process of rehabilitation. During disasters, disaster relief shelters can be important in the health care delivery system and overall access to health care, because they often incorporate minor medical services within their shelters. Residents residing at the shelter may seek treatment for minor medical services at the disaster relief shelter, reducing the patient volume of local emergency departments. Disaster relief shelters can be coordinated and managed by a variety of organizations or governmental emergency management departments. Within Harris County, HCOHSEM and other emergency management agencies in Harris County, including the Houston Office of Emergency Management, are responsible for coordinating the opening of disaster relief mass shelters within their respective jurisdictions, during emergencies, as needed. During Hurricane Harvey, both the Harris County and Houston disaster relief mass shelters, respectively, had the capacity to care for approximately 10,000 residents.

Both disaster relief mass shelters utilized their LHDs to coordinate medical partners and integrate services such as mental health, medical, and other support services into the shelter operations. Harris County and the City of Houston currently have agreements with the American Red Cross (ARC) to operate over 100 shelters in the event of an emergency, if necessary. These agreements mean that the ARC has a facility agreement, has surveyed the property, has determined its sheltering capacity, and understands its ability to provide services that are compliant with the American Disability Act (ADA) and Functional Needs Support Services (FNSS).

The ARC also has a list of 30 shelters for which no agreements exist but may provide sheltering services in the event of an emergency. These remaining 30 shelters are primarily worship and community centers. It should be noted, however, that not all shelters would be open at a given time during an emergency. The specific shelters that would be activated during an emergency depend on the size, magnitude, and location of the event. Excluding the two mass shelters operated by Harris County and the City of Houston, these smaller satellite shelters have a capacity to care for approximately 27,000 people in total.

While the health and medical response to Hurricane Harvey by both Harris County and the City of Houston was strong and appropriate, it also relied on community members and their willingness to relocate, even if temporarily, to a mass shelter. However, there is concern that fear of "public charge" and other federal policy on immigration may inhibit residents from leaving their homes and accessing disaster shelters during public health emergencies. If realized, this could pose a significant threat to preparedness and emergency rescue resources, who will need to coordinate with residents who may be unwilling or unable to seek help. Further policy discussions related to how such policies impact communities such as Harris County in the midst of emergencies – especially given the large-scale ones that Harris County has experienced over the years – are crucial to ongoing community health, protection, and resilience.

"We may not always have plans for the unknown, but we make it work."

-Dr. David Persse, Local Health Authority, City of Houston

Emergency Preparedness in Action: Case Examples

Emergency Preparedness in Action: Intercontinental Terminals Company Fire Event

On Sunday, March 17, 2019 a fire began at Intercontinental Terminals Company (ITC) in La Porte, Texas. As a result, the HCOHSEM activated the Harris County Emergency Operations Center (EOC) and requested county partners to report to the EOC, including HCPH, SETRAC, Harris County Fire Marshall's Office (HCFMO), Harris County Pollution Control Services (HCPCS), and others.

In terms of medical coordination, the health and medical desk was staffed by HCPH. SETRAC activated CMOC and began coordinating patient tracking through *EMTrack*. Throughout the incident, HCPH conducted active and syndromic surveillance in coordination with CMOC to monitor symptoms possibly related to the incident. Health care partners were provided with multiple Health Alert Network (HAN) messages over the course of the response (which lasted days) regarding the fire and potential associated signs and symptoms. HCPH held Mobile Health Impact Team (HIT) events at community centers between March 21 and March 30 in Deer Park and Galena Park, respectively. It should be noted that these were the communities that had called for a shelter-in-place during the timeframe of the ITC fire response. Residents were provided with health screenings, vaccinations, health education, and other health-related services. The health screenings were coordinated through Harris Health and helped handle the increase in community concerns for benzene exposure by the impacted community. Harris Center also assisted in the response by providing mental and behavioral health specialists for crisis counseling at Mobile HIT locations. Additionally, Harris Health set up an incident-related call line from March 21 to April 4 to field calls related to the incident utilizing its community-wide "Ask My Nurse" system.

As part of the emergency response, HCPH was requested to lead the air monitoring efforts to the event in coordination with other partners, while HCPCS along with other partners led the coordination of other environmental (soil, sediment, and water) samples that were taken from around Harris County. While many county and partner agencies were involved in the response to ITC, HCFMO played a critical part to Harris County's response and was particularly active for the on-scene county-related efforts for the fire.

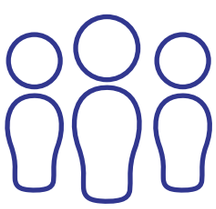
On April 9, 2019, Harris County Commissioners Court approved a contract with PENTA Consortium, LLC, to develop a comprehensive Multi-Agency Coordinating Group Gap Analysis to identify important gaps in Harris County's capacity to prevent, prepare for, and respond to

Case Example: LA County Department of Mental Health

Los Angeles County Department of Mental Health – Underserved Cultural Communities (UsCC) A cornerstone of the LA County Department of Mental Health (LACDMH), the UsCC empowers underrepresented ethnic/cultural groups to participate in the decision-making process for mental health services. The UsCC subcommittee work closely with community partners and consumers to increase the capacity of the public mental health system and develop culturally competent recovery-oriented policies and services specific to the UsCC communities.[396] The Eastern European/Middle Eastern UsCC subcommittee recommended the development of a mental health talk show in the Armenian language to reduce stigma and increase awareness about the signs and symptoms of mental illness. This project resulted in a 500% increase in calls from Armenian community members to the LACDMH Access Line to seek service and information.[397]

incidents like the fire and HazMat incident that occurred at ITC. The gap analysis looked at plans, training and competencies, resources, capabilities, and facilities; reviewed where Harris County currently stands and where it needs to be to ensure the safety and security of residents; and how to effectively share accurate, timely, and vetted information with decision-makers to keep stakeholders informed.

In response to this analysis, during the September 10th Harris County Commissioners Court, $11.6 million was approved so that the necessary supports are available to implement recommendations to collaborate, target resources, and hire several positions to protect Harris County in the face of emergency incidents such as ITC (it should be pointed that two additional plant explosions also occurred in 2019 further underscoring the need for capacity-building across the spectrum). Specifically, $5.9 million was allocated to HCPCS for positions such as emergency response workers, chemists, field investigators, and the creation of a new mobile air monitoring lab; $4.6 million towards additional personnel, proper equipment, and facilities for HCFMO; and, $1.1 million for HCPH for various positions such as a chemical response planner, certified industrial hygienist, epidemiologists, and physicians.



"...residents needing medical care... were transferred to the medical care shelter which had a 250-bed capacity..."

Emergency Preparedness in Action: Hurricane Harvey

As a result of Hurricane Harvey, two disaster relief mass shelters were opened by the City of Houston and Harris County within their respective jurisdictions. Both mass shelters had the capacity to care for approximately 10,000 residents each. Harris County enlisted BakerRipley to manage their shelter activities and the City of Houston utilized ARC. Both shelters had their LHDs incorporated into unified command to provide support services such as sanitation, shelter assessments, epidemiological services, immunizations, and medical care in coordination with partners such as Baylor of College Medicine, Harris Center, Harris Health, Harris County Medical Society (HCMS), and UTHealth School of Public Health , among others.

For the Harris County disaster relief mass shelter, residents needing medical care above the capabilities of the disaster relief mass shelter were transferred to the medical care shelter which had a 250-bed capacity under the management of HCPH and Texas DSHS resources. The City of Houston disaster relief mass shelter also had the capacity to handle approximately 250 medical needs patients. Pharmaceutical services were provided through existing agreements with private companies such as CVS, Randall's, and Kroger. During Harvey, the Harris Center offered mental and behavioral health services to volunteers and evacuees. In addition to the two disaster relief mass shelters, many other shelters across the state were also opened which is a testament to the resilience of the Harris County community and the strong community cohesion and private infrastructure available to support the needs of Harris County during a disaster. Figure 2.17 shows the spikes in calls to 2-1-1 during Hurricane Harvey and the recovery period that followed. East Little York-Settegast and Central Southwest-COH Fort Bend had the highest number of calls. The top three needs of the callers were: disaster food stamps, food pantries, and FEMA Disaster Assistance registration (Figure 2.18).

Figure 2.17 Calls to 2-1-1

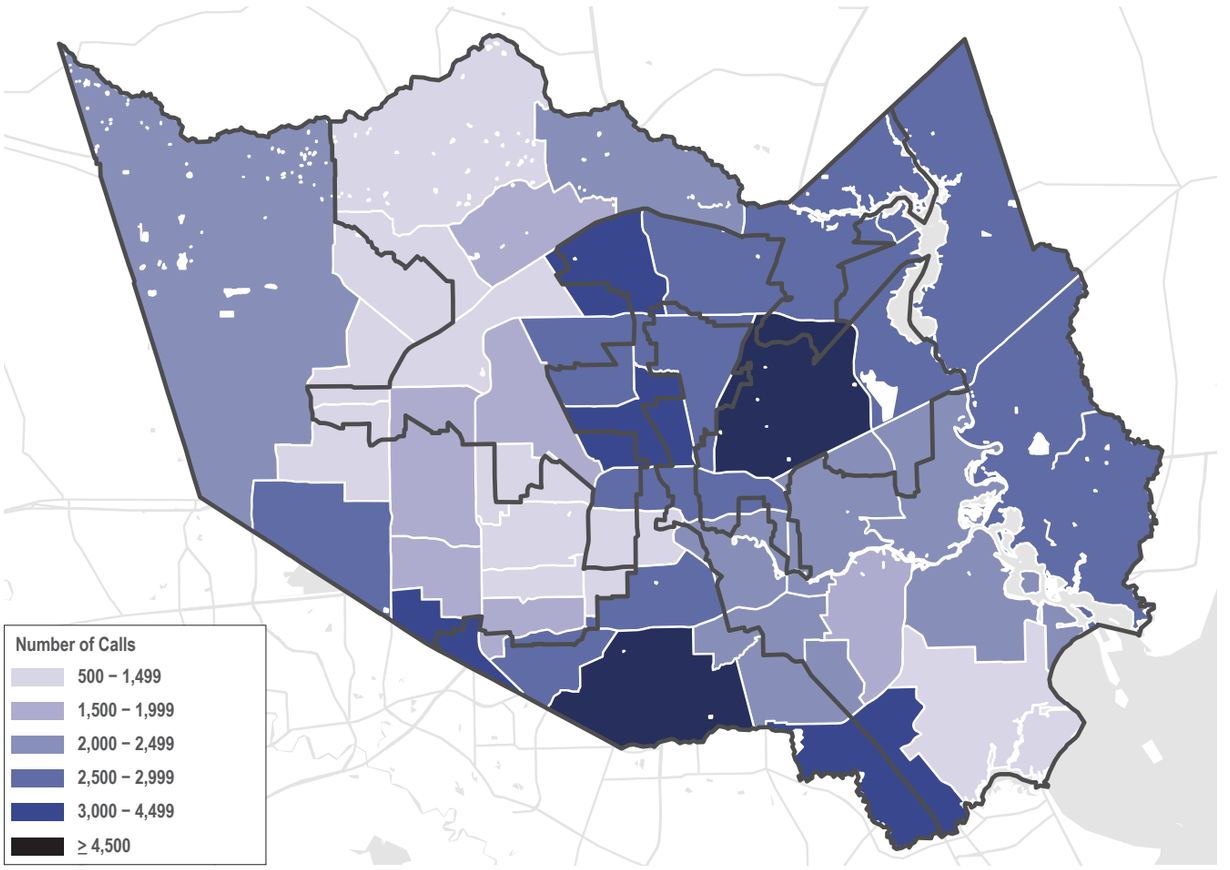


Figure 2.17 Total Calls to 2-1-1 During Hurricane Harvey and Recovery, Harris County, TX, 08/25/2017-11/30/2017.
Source: United Way of Greater Houston.

Figure 2.18 Needs Reported to 2-1-1

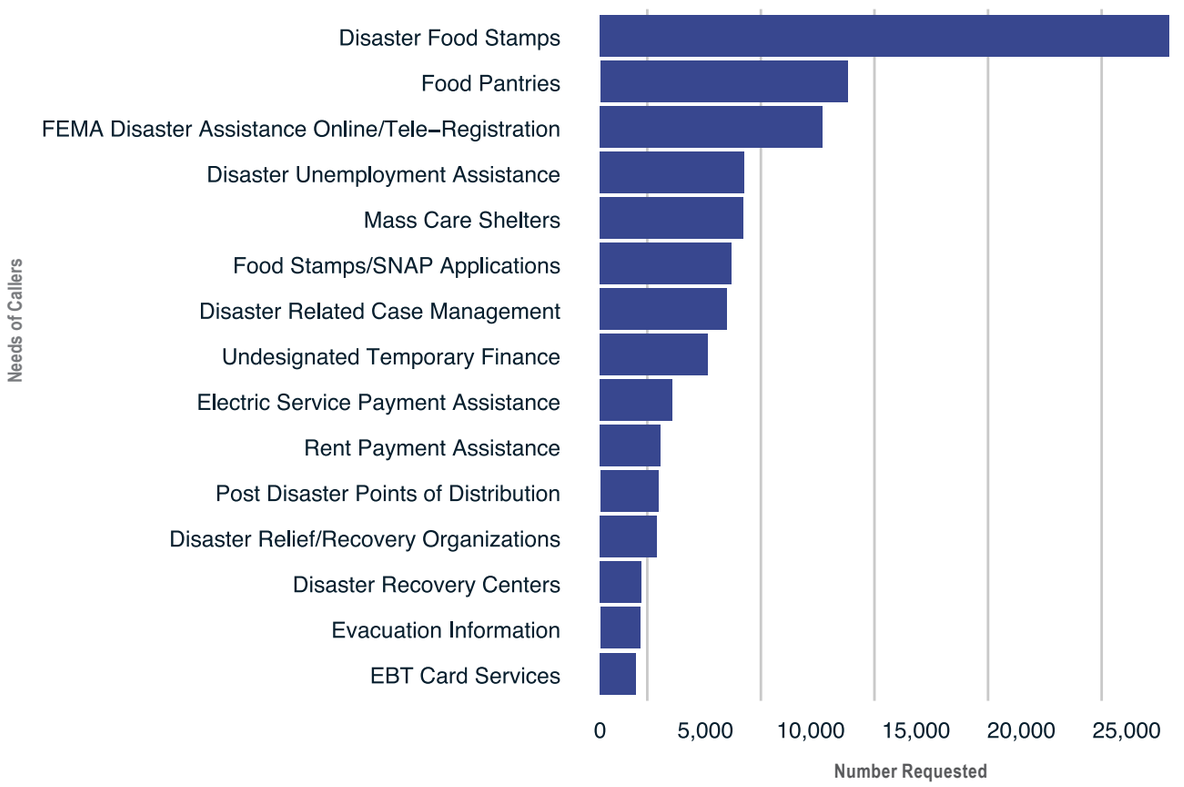


Figure 2.18 Top Needs Reported On 2-1-1 Calls During Hurricane Harvey and Recovery, Harris County, TX, 08/25/2017-11/30/2017.
Source: United Way of Greater Houston.

The tracking of shelter residents was identified as a challenge among all Harris County shelters. All shelters utilized a paper system for resident registration, medical assessment, and other tracking related activities. Both mass shelters reported a significant discrepancy between the reported numbers of shelter residents by the organization managing the shelter operation (i.e., BakerRipley for Harris County and the ARC for the City of Houston) and the local health department performing shelter assessments (i.e., HCPH and HHD). For future emergencies, a usable electronic platform for patient tracking that is compatible throughout multiple disciplines and jurisdictions should be considered and point towards interoperability of health and social services data sharing.

Caring for patients with chronic conditions such as diabetes, ESRD, and chronic psychiatric and mental health disorders was also a challenge for the shelters. Prior to the arrival of pharmaceutical services, there was minimal ability to assist residents with medication refills for their chronic conditions. Because of this, some residents experienced an exacerbation of their chronic conditions which jeopardized their health, and in some cases, required transport to a higher level of care.

Credentialing of medical professionals was identified as an area of concern for all shelters, including the ARC. Although the ARC does credential medical professionals before an incident, incorporating and credentialing spontaneous medical volunteers is still a challenge due to the time it takes and connectivity issues during emergencies. All shelters reported difficulty with allowing individual external volunteers to work as medical professionals due to medical malpractice and license verification concerns. There is currently no clear and quick process for credentialing medical professionals during emergencies.

"Both mass shelters reported a significant discrepancy between the reported numbers of shelter residents..."

Figure 2.19 EMS Calls and Population

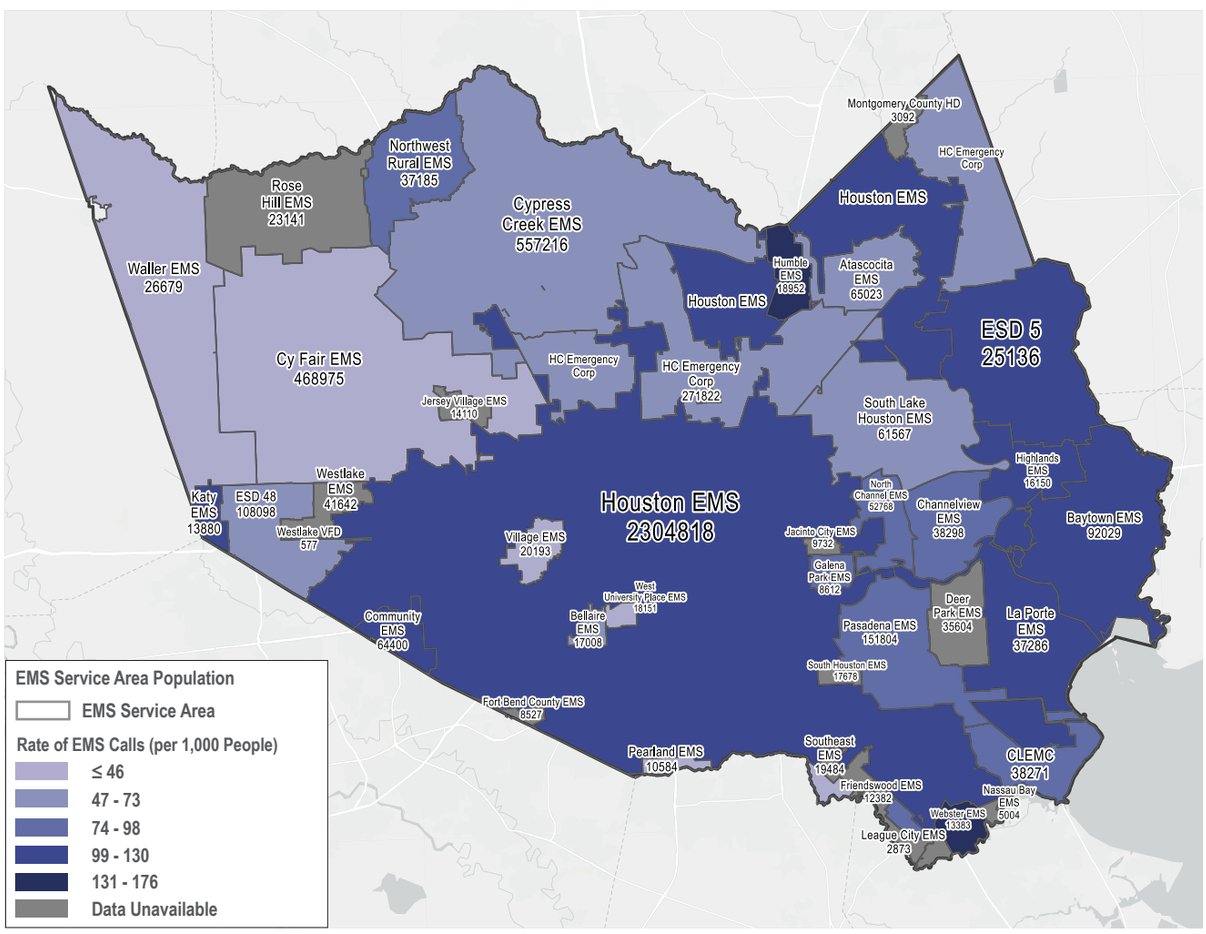


Figure 2.19 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.
Source: Esri Demographics, 2018; Office of Public Health Preparedness and Response, Harris County Public Health; Greater Harris County 9-1-1 Emergency Network, 2019.

Figure 2.20 Total ED Visits

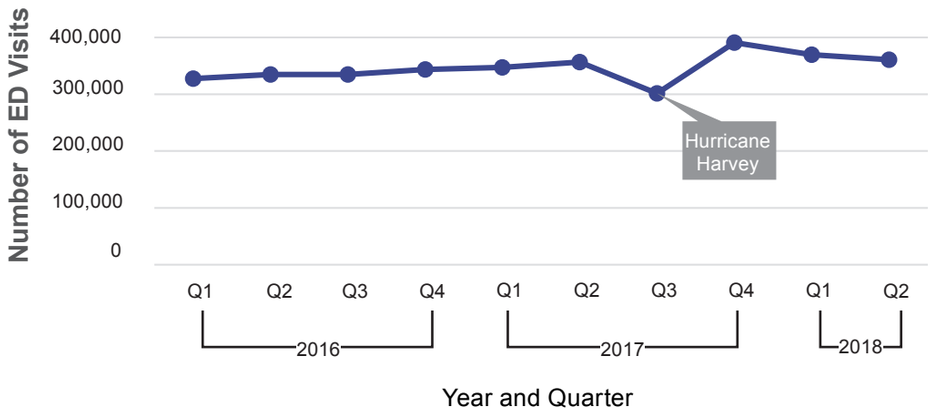


Figure 2.20 Number of Total Emergency Department Visits, Harris County, TX, Q1/2016-Q2/2018.
Source: Center for Health Statistics, Texas Department of State Health Services, 2016-2018.

Immediately following Hurricane Harvey, EMS reported that average transport times increased significantly from daily averages. Figure 2.19 illustrates that the rate of EMS calls during 2017 along with the population for each EMS service area. We can see that some EMS areas have an extremely high rate of EMS calls. For example, the Webster EMS services 13,383 residents and has more than 170 calls per 1,000 people. Many EMS agencies could not access typical travel routes and either had to transport to the only hospitals they could access or not at all due to flooding. Additionally, although many EDs reported decreased volume during and immediately following Hurricane Harvey, ED volume spiked to an all-time high in the fourth quarter of 2017 as evidenced by Figure 2.20.

Access to dialysis care during and immediately following Hurricane Harvey was also found to be a challenge. During interviews with EMS agencies, they reported that calls came to the dispatcher for patients seeking dialysis services who were unable to receive care at their normal dialysis center due to flooding or the high volume of patients seeking services. Figure 2.21 shows the percentage of ED visits due to end-stage renal disease. Hurricane Harvey likely contributed to the observed spike in the third quarter of 2017. Figure 2.22 shows rates of end-stage renal disease visits in 2017 overlaid with available dialysis centers. There are areas in Harris County that have a relatively high concentration of end-stage renal disease visits, but not within close proximity to a dialysis center.

Additionally, finding placement, and ultimately transportation to and from dialysis centers, for patients needing scheduled dialysis was a challenge for both disaster relief mass shelters. Many dialysis centers were affected by Hurricane Harvey and thus were unable to provide services to their patients. Open dialysis centers were contacted through a variety of methods including CMOC and *EMTrack*. Once verified open and operational, patient transport to facilities was arranged.

Transportation to and from shelters to dialysis centers was arranged with the help of rideshare services such as Lyft and Uber, and Metro, among others. Incorporating rideshare services such as Lyft or Uber into the planning phase of emergency preparedness may help transportation concerns in the future. This was also seen during other emergencies across the country including the mass shootings at a concert in Las Vegas in 2017 in which rideshare services played significant role in transports to area hospitals.[186] However, Lyft, for example, has stated that although this concierge service may have worked during Hurricane Harvey, it may not be able to support transportation during all types of

Figure 2.21 ED Visits Due to ESRD (%)

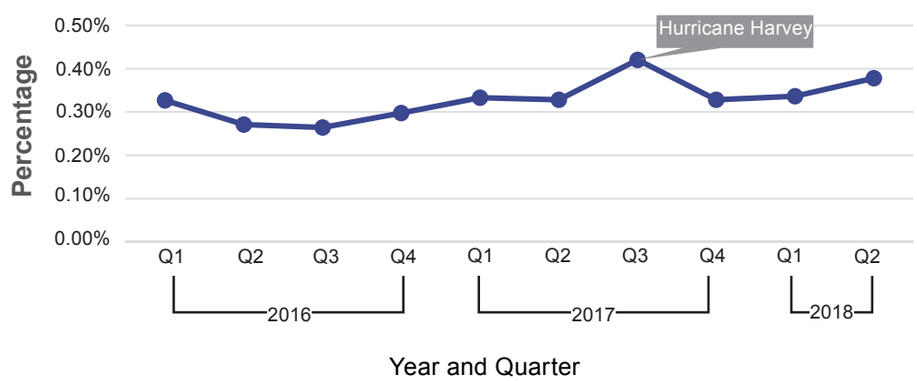
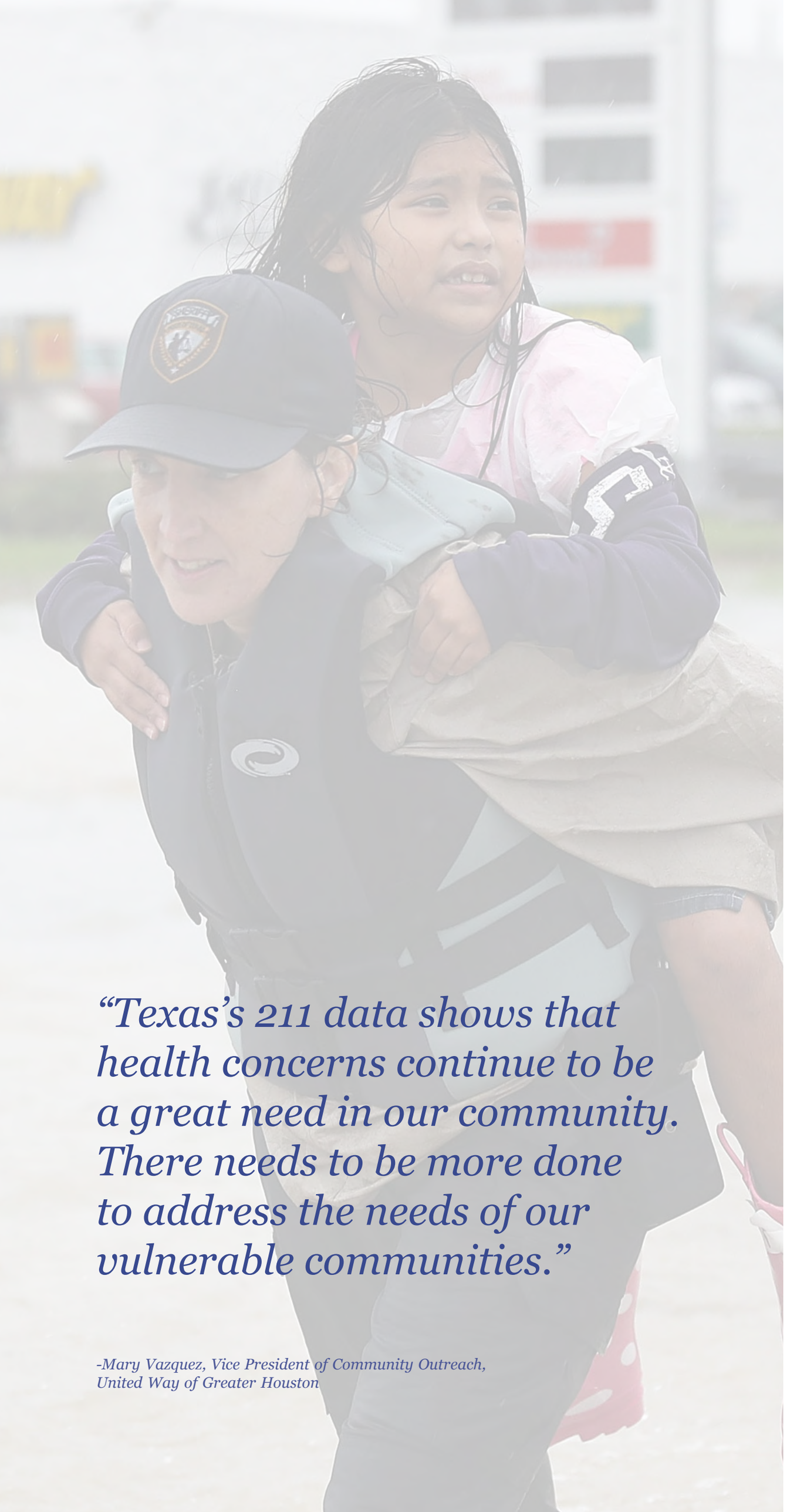


Figure 2.21 Percentage of Emergency Department Visits Due to End-Stage Renal Disease, Harris County, TX, Q1/2016-Q2/2018.
Source: Center for Health Statistics, Texas Department of State Health Services, 2016-2018.



"Texas's 211 data shows that health concerns continue to be a great need in our community. There needs to be more done to address the needs of our vulnerable communities."

-Mary Vazquez, Vice President of Community Outreach, United Way of Greater Houston

emergencies.[187] Alternative strategies and/or discussions with such transport services about their concerns to help mitigate them may be important for future incidents.

In the aftermath of Hurricane Harvey, the academic and public health community came together to help build the *Hurricane Harvey Registry*, led by Rice University.[188] This registry allowed public health officials to understand the impacts of Hurricane Harvey on their community. In 2019 they released their initial report that detailed their findings.[189] The registry has since been repurposed and redeployed for other events, including Tropical Storm Imelda.

Emergency Preparedness in Action: Zika Response

In 2016, HCPH coordinated the public health Zika virus response efforts for Harris County in conjunction with other partners such as Texas DSHS, HHD, and other local stakeholders. At the time, Zika virus was an emerging viral disease transmitted by mosquitoes of significant concern due to its effects on fetal development, potential for international spread given the geographical distribution of the mosquito vector, the lack of population immunity in newly affected areas, and the absence of vaccines, specific treatments, and rapid diagnostic tests.

The main goals of both local health departments were to prevent the spread of the Zika virus within Harris County utilizing a variety of strategies including education and engagement campaigns to increase public knowledge of the Zika virus,

Figure 2.22 ESRD Facilities and ED Visits

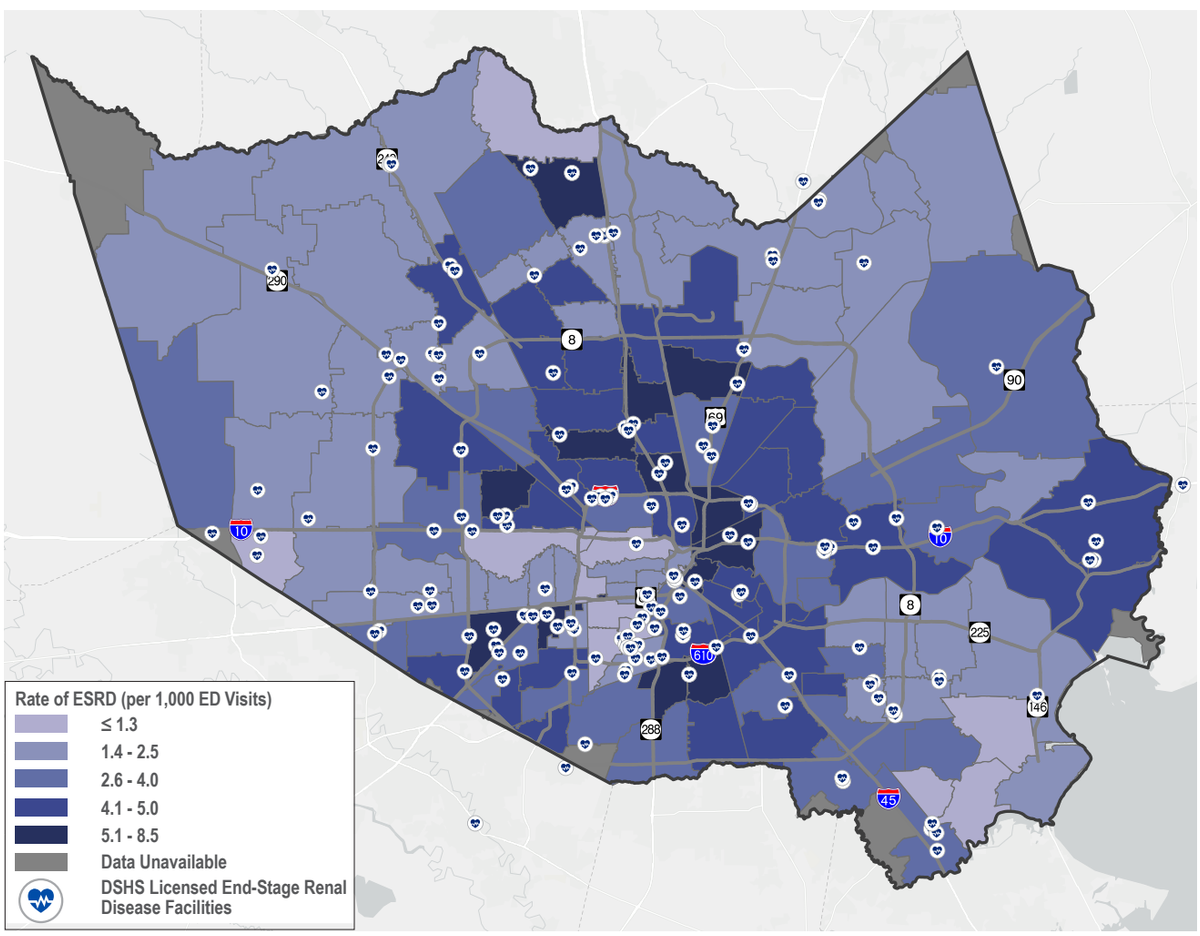


Figure 2.22 End-Stage Renal Disease Facilities and Emergency Department Visits Due to End-Stage Renal Disease per 1,000 Visits by Zip Code, 2017.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019; Center for Health Statistics, Texas Department of State Health Services, 2017.



EMERGENCY PREPAREDNESS

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 8 Recommendations

- Analyze the effectiveness of existing dispatch and/or encryption systems in Harris County EMS and other response agencies to improve communication before, during, and after emergencies.
- Enhance the existing infrastructure of dialysis to address end stage renal disease needs better, particularly during and after emergencies.
- Support Harris County community resilience strategy to include both human and infrastructure resilience.
- Strengthen Harris County resources and tools available for disaster preparedness, response, and recovery for all county residents, with a particular emphasis on those who are disproportionately impacted by emergencies.
- Enhance existing agreements and develop new ones with key nonprofit, for profit, academic, and other partner organizations for resources needed during emergencies.
- Support efforts to ensure universal use of electronic medical records throughout Harris County, which can be leveraged during emergencies.
- Encourage participation in an electronic health information exchange within Harris County to allow seamless data sharing and communication across sectors, especially during emergencies.
- Enhance Harris County communication, collaboration, and coordination with all residents, with a particular emphasis on those who are disproportionately impacted by emergencies.
- Foster cross-sector collaboration amongst public, private and nonprofit entities engaged in transportation to build a robust system that appropriately matches patient needs with available health care options, especially during emergencies.

"The only thing that happens in an emergency is that people coalesce and issues that have always been there become more easily visible."

-Health System Stakeholder

conducting epidemiological surveillance, providing data and clinical guidance to partners regarding Zika virus, and serologic testing. HCPH and HHD provided joint messages to health care partners by using the HCPH-operated Houston-area Health Alert Network (HAN). Additionally, because HCPH provides mosquito control services to Harris County including all cities within it, HCPH was able to incorporate in a unified manner vector surveillance and control operations, including larvicide and outdoor treatment, into the coordinated county response. HCPH then in turn was able to provide this vector surveillance and control measure data to HHD and other municipalities.

Because Zika was a vector-borne illness of public health significance in the near past, LHDs must remain vigilant in planning for future similar emergencies. Vector-borne illnesses could arise again also following other emergencies such as floods or could be the cause of a new public health emergency such as was the case with Zika. Active, engaged, and robust surveillance systems as well as ensuring appropriate emergency response activities to mitigate such emergencies are key to future response.

Climate Change: Emergency Preparedness

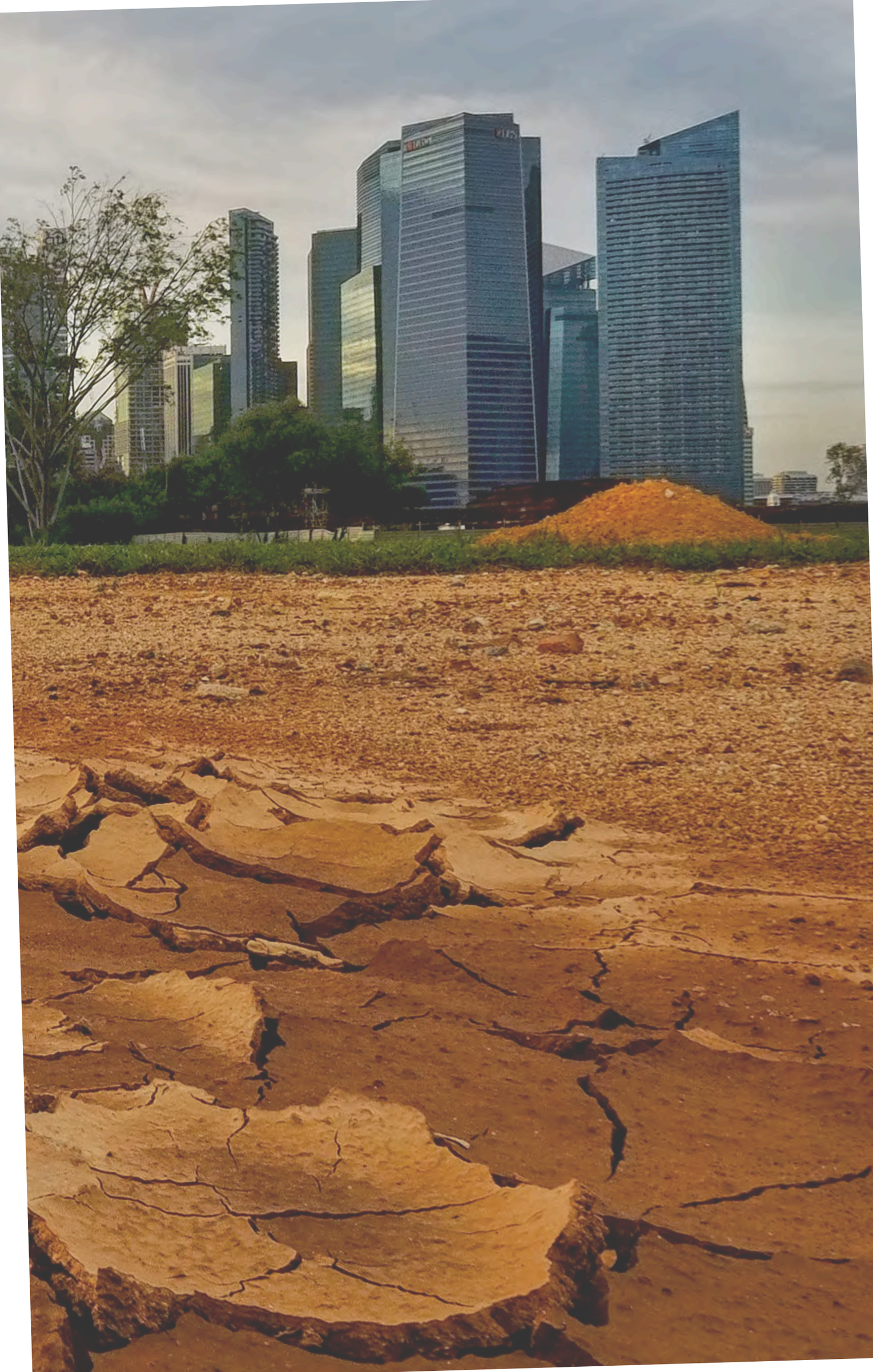
Climate change is defined as sustained changes to climate patterns which includes temperature shifts as well as severe weather events. Because climate change may increase the frequency and intensity of disasters, the growing disaster risks desensitizes residents to extremes in which the scale of disasters may increase in frequency and intensity.[190] In addition to the given damage and negative health effects produced by severe weather events, such occurrences disproportionately affect areas that are rated highly on the social vulnerability index.[191] **As such, it is vital to develop local capacity with respect to climate adaptation in a cost-effective manner to mitigate the impact of climate change on impacted residents and their communities.** This could include preparing prevention interventions and improving practical knowledge on a community level to develop local resiliency.[192] Among the top two percent of disaster-prone areas in the United States, Harris County must be prepared for the impact of increased frequency of hurricanes and disasters.[193]

Conclusion

Harris County has seen its share of public health emergencies, and these have shown that appropriate investment in public health and health care delivery is necessary for a community's safety and resilience. Each emergency has taught us invaluable lessons. Case in point, due to the significant investment in public health and health care infrastructure in the aftermath of Tropical Storm Allison and other storms such as Hurricane Ike, Hurricane Harvey caused only 10% of our area's hospitals to be inoperable or required evacuation. Investments can and do pay off.

In closing, efforts toward building healthy and resilient communities require proactive, capable, and responsive public health and health care systems. This approach is also required in areas of community preparedness, laboratory testing, surveillance and epidemiological investigation, emergency operations coordination, public health awareness infrastructure, and others. Investments in smart, forward-facing technologies and information systems are equally critical to the success of response capabilities and must also be remembered.

Such efforts will not only help communities recover faster from an emergency but will reduce the impact of that emergency. **The more resilient a community is, the better it is able to resist, respond, and recover from a disaster.**







"Globally, environmental conditions account for nearly 25% of all deaths and likely comprise 70-90% of the total risk in the development of chronic diseases."[194,195]

9

The Environment

A person's daily surroundings, again utilizing the framework of where an individual lives, learns, works, worships, and plays, has significant impact on one's health. Environmental conditions such as air pollution, poor water quality, and toxic chemicals are known to cause illness, reduce life expectancy and negatively affect the quality of life. The built environment includes all of the physical parts of where we live and work including housing, open green spaces, infrastructure, and sidewalks, which acts as the "scaffolding" for the community and plays a significant role in determining the health and quality of life of residents.

Given the significant size of Harris County's infrastructure-related budget and its ability to articulate others should pay attention to optimal community design means that these and other county activities can play an important role in shaping a community's built environment., It's plausible that one of the most impactful steps to improve health in Harris County is through innovative leveraging of infrastructure budgets with health outcomes in mind. This gets to the heart of the California-based BARHII model: stated differently, improving health through upstream factors can help mitigate the downstream costs of health care.



Introduction & Background

Globally, environmental conditions account for nearly 25% of all deaths and likely comprise 70-90% of the total risk in the development of chronic diseases.[194,195] People most susceptible to environmental pollution are children under five years old and adults between 50 and 75 years old.[196] Minority communities, often marginalized either by status or even geographic location within a community - with high levels of poverty are particularly disproportionately affected, experiencing both higher levels of environmental pollution and reduced access to health care.[197] The Clean Air Act of 1990 and the Clean Water Act of 1972 established limits on air and water pollution to safeguard the public's health with these and other concerns in mind. However, air and water pollution in Harris County, a highly industrialized area, regularly exceed these limits, posing challenges in the years to come.[198,199]

Regular exposure to environmental contaminants can have significant downstream effects on the health outcomes for Harris County residents regardless of what individual steps they may take to mitigate against these elements. In other words, if a community member is subjected to conditions that impact the entirety of his or her neighborhood, exercising in that neighborhood or eating healthier foods, may not fully solve the adverse health paradigm that person is subjected to over time.

In 2019, HCPH conducted an internal review of Community Health Needs Assessments (CHNA) created by area hospitals. The review was to determine the level of alignment with HCPH priorities, including social and economic conditions, access to care, injury, mental health, chronic disease, obesity, maternal and child health, sexually transmitted infections (STIs), and air and water quality, respectively. Not surprising, air and water quality were not mentioned in any CHNA and could lead one to believe that there is a disconnect between the prioritization of environmental factors for adverse health outcomes and the health system forced to mitigate or operate downstream.[200]

Air Quality

For Harris County government, Harris County Pollution Control Services (HCPCS) is the lead agency in monitoring and responding to air pollution. Though HCPCS has a central role, other agencies such as HHD, the Texas Commission on Environmental Quality (TCEQ), and other public and private partners monitor air quality. Although HCPH does not itself conduct air monitoring, the resultant impact of air quality on the health and well-being of Harris County residents is a public health concern.

A local study of Harris County air quality found cancer risk from air pollution in some communities such as Harrisburg/Manchester and Galena Park to be 20%-30% higher than other Harris County communities such as West Oaks/Eldridge and Bellaire.[201] Additionally, the National Air Toxics Assessment (NATA) calculated cancer risk from air pollution for the nation and found that much of eastern Harris County falls within the top 95-100% highest risk category for cancer risk in the state (Figure 2.23).[202] The Environmental Protection Agency (EPA) estimates air toxics cancer risk and lifetime cancer risk from inhaling air toxics and is shown as a rate of risk per lifetime per one million people. TCEQ and EPA data also shows significant quantities of air pollution in the east side of Harris County (Figures 2.24, 2.25). Figure 2.26 indicates the average number of vehicles per day at major roads, divided by distance.

It is well known that air pollution has direct and indirect health-related consequences. It contributes to five million premature deaths every year worldwide.[203] It may cause or aggravate respiratory diseases, such as allergies, pneumonia, bronchitis, COPD, and asthma. It also increases the risk of cardiovascular disease, diabetes, cancer, stroke, and Alzheimer's disease.[204]

Table 2.1 Specific Preventable Adult Hospitalization Charges

Preventable Hospitalization Indicators	Total Associated Charges
Diabetes Long-Term Complications	$523,000,000
Chronic Obstructive Pulmonary Disease or Asthma	$426,000,000
Urinary Tract Infection	$426,000,000
Bacterial Pneumonia	$232,000,000
Angina without Procedure	$211,000,000
Hypertension	$204,000,000
Diabetes with Lower Extremity Amputation	$179,000,000
Diabetes Short-Term Complications	$121,000,000
Heart Failure	$114,000,000
Uncontrolled Diabetes	$101,000,000
Dehydration	$88,400,000

Table 2.1 Charges for Specific Preventable Adult Hospitalization Indicators, Harris County, TX, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Figure 2.23 Cancer Risk from Inhalation of Air Toxics

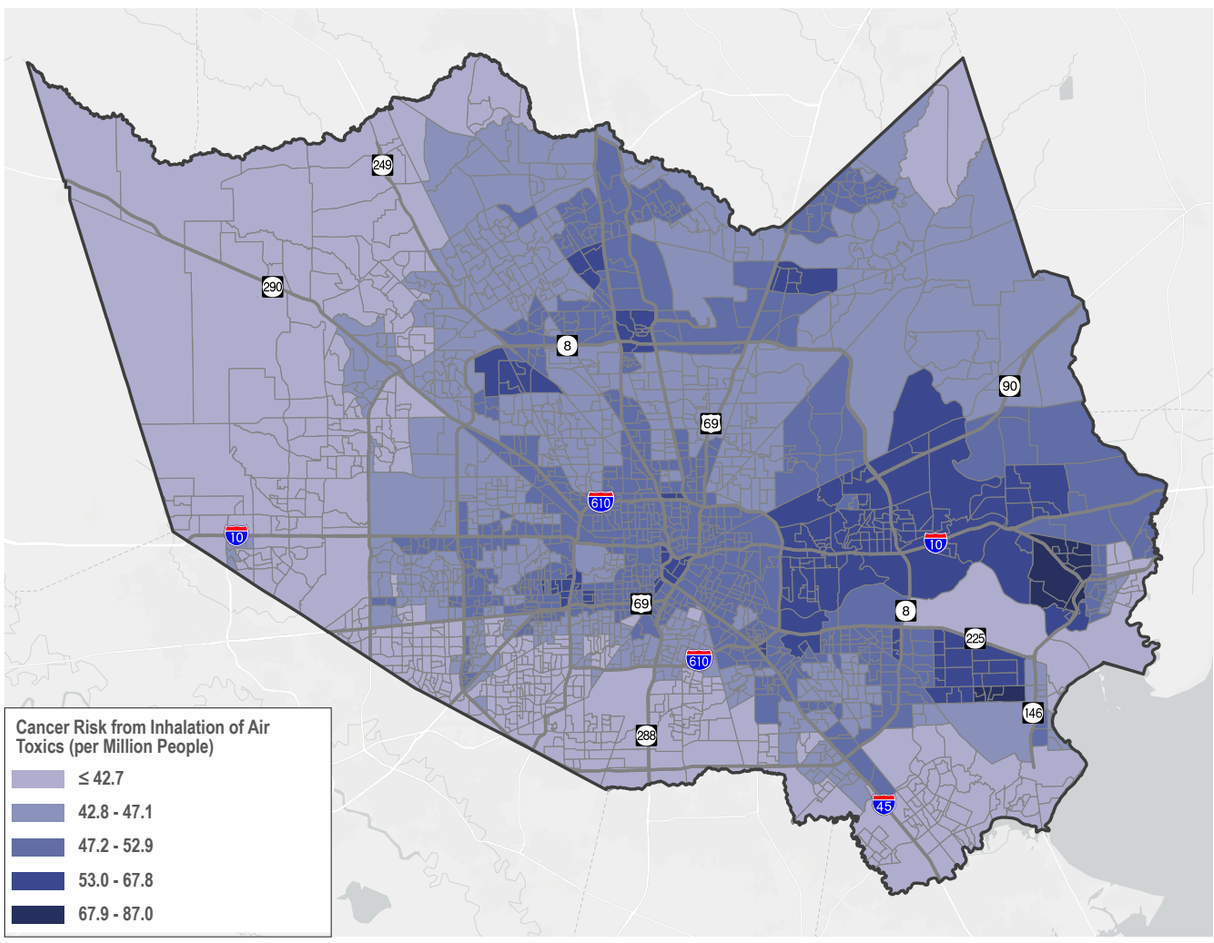
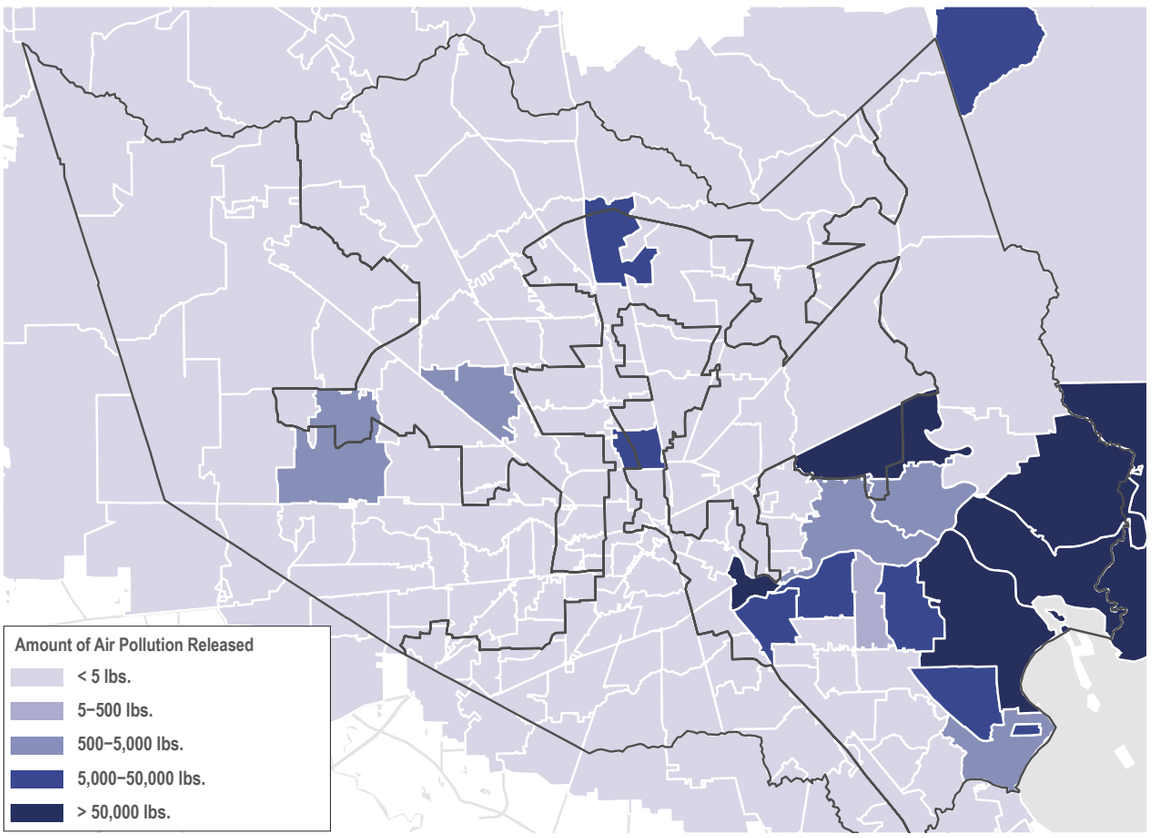


Figure 2.23 Cancer Risk from Inhalation of Air Toxics by Census Block, Harris County, TX, 2018.
Source: US Environmental Protection Agency, 2018.

Figure 2.24 Amount of Air Pollution (lbs) Released



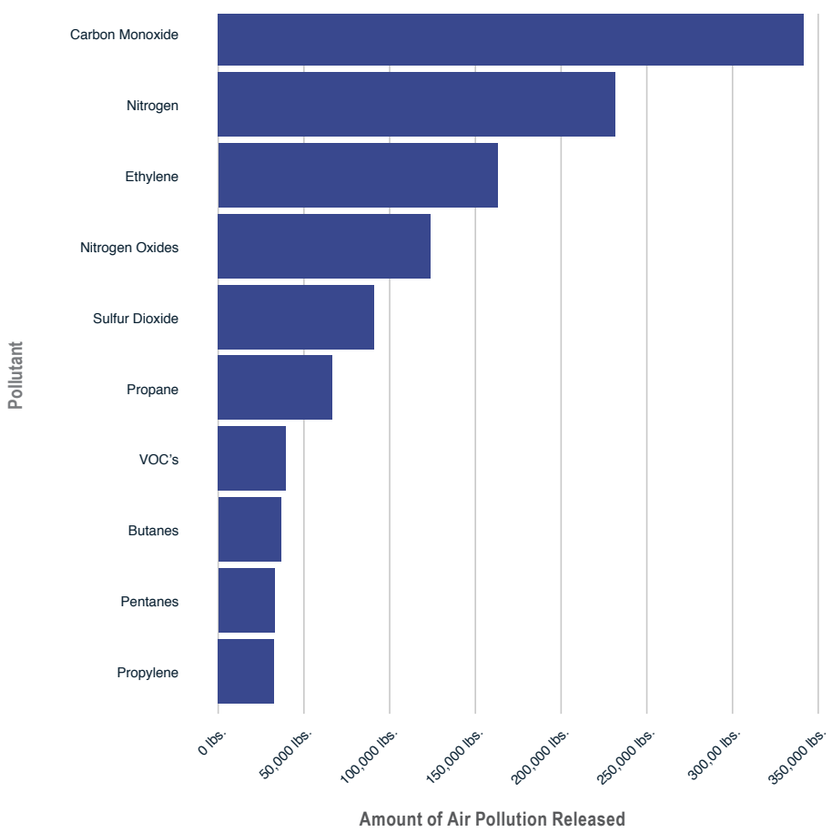


Figure 2.24 Amount of Air Pollution (lbs) Released by Zip Code and Chemical, Harris County, TX, 08/27/2018-08/27/2019.
Source: Texas Commission on Environmental Quality, 2018-2019.

Figure 2.25 Air Toxics Respiratory Hazard Index

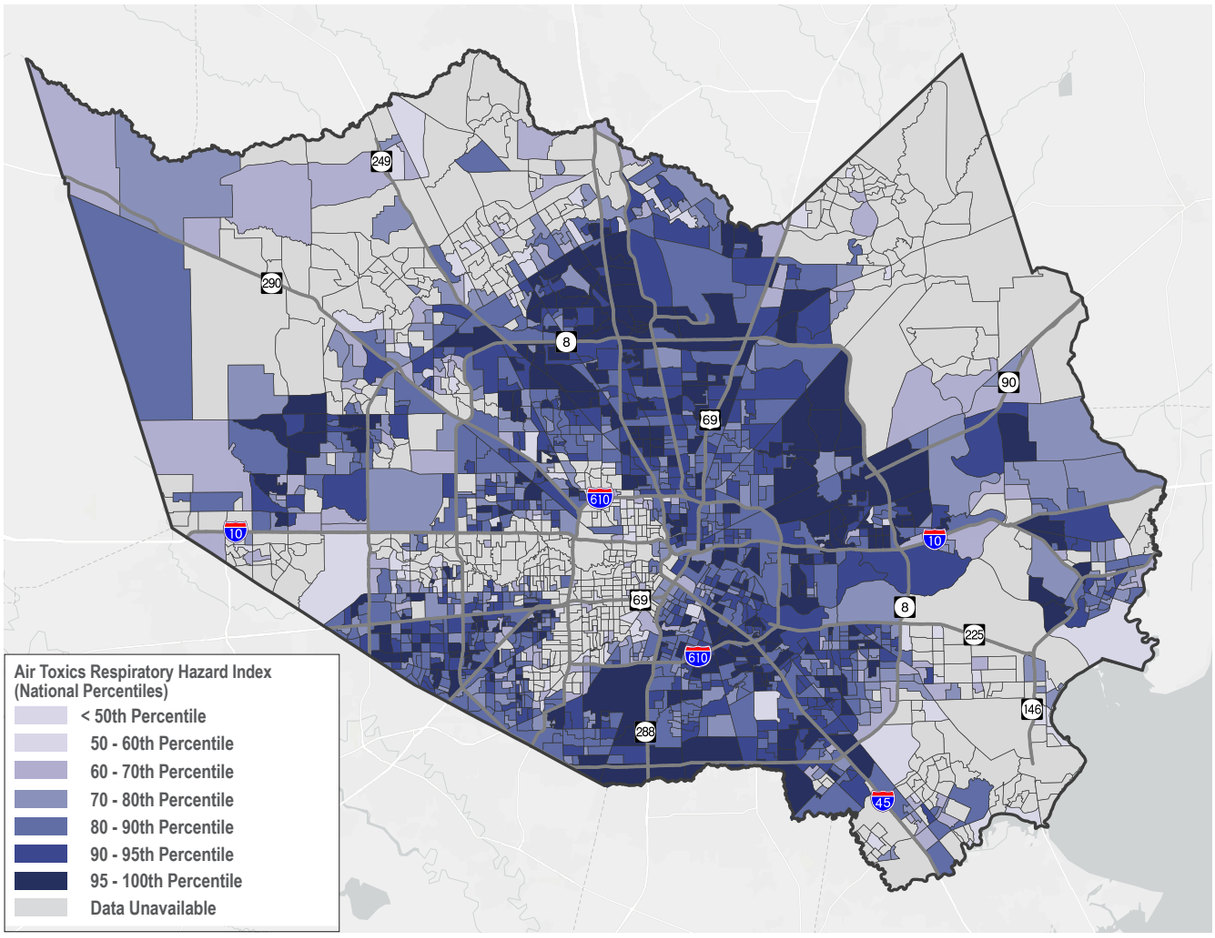


Figure 2.25 Air Toxics Respiratory Hazard Index by Census Block, Harris County, TX, 2018.
Source: US Environmental Protection Agency, 2018.

Periods of poor air quality are associated with an increase in hospitalizations and deaths from respiratory and cardiovascular disease. In Houston, some areas of the city are six times more likely to have ambulance treated asthma attacks than other parts of the city.[205] The value proposition for asthma prevention programs is evident when considering asthma/COPD is the second costliest preventable hospitalization in Harris County (Figure 2.27, Table 2.1).

Volatile Organic Compounds and Particulate Matter

Air pollution is caused by several hundred different types of organic and inorganic compounds, largely produced by human processes, such as the burning of fossil fuels in vehicles and power plants and the release of waste gases from chemical manufacturing. Given the large number of potential pollutants in the air, air quality is most commonly measured in terms of Volatile Organic Compounds (VOCs) and Particulate Matter (PM). VOCs are lightweight carbon-containing molecules such as methane, ethylene, and benzene that exist as vapors or readily vaporize at room temperature, while PM consists of suspended solid or liquid particles regardless of chemical composition, grouped by particulate size.[206]

PM is associated with increases in deaths and lower life expectancy. Long-term exposure increases risk of diabetes, Alzheimer's, and mental health problems. Children in particular are a high-risk group because their lungs are still developing. Those born in areas with higher levels of air pollution are at higher risk of being born preterm, having reduced lung growth and reduced lung function.[207] In 2017, the EPA determined that many of the top five air pollutants released into the environment by industrial facilities in Harris County were VOCs.[208] These compounds are not evenly distributed. Figure 2.25 is a map of the Air National-Scale Air Toxics Assessment (NATA) Respiratory Hazard Index, which combines risks associated with all toxic air pollutants in relation to their health-based reference concentrations. It shows that many areas that fall within the top 80-100% risk category for the state of Texas are in eastern Harris County.[209]

Figure 2.26 Traffic Proximity

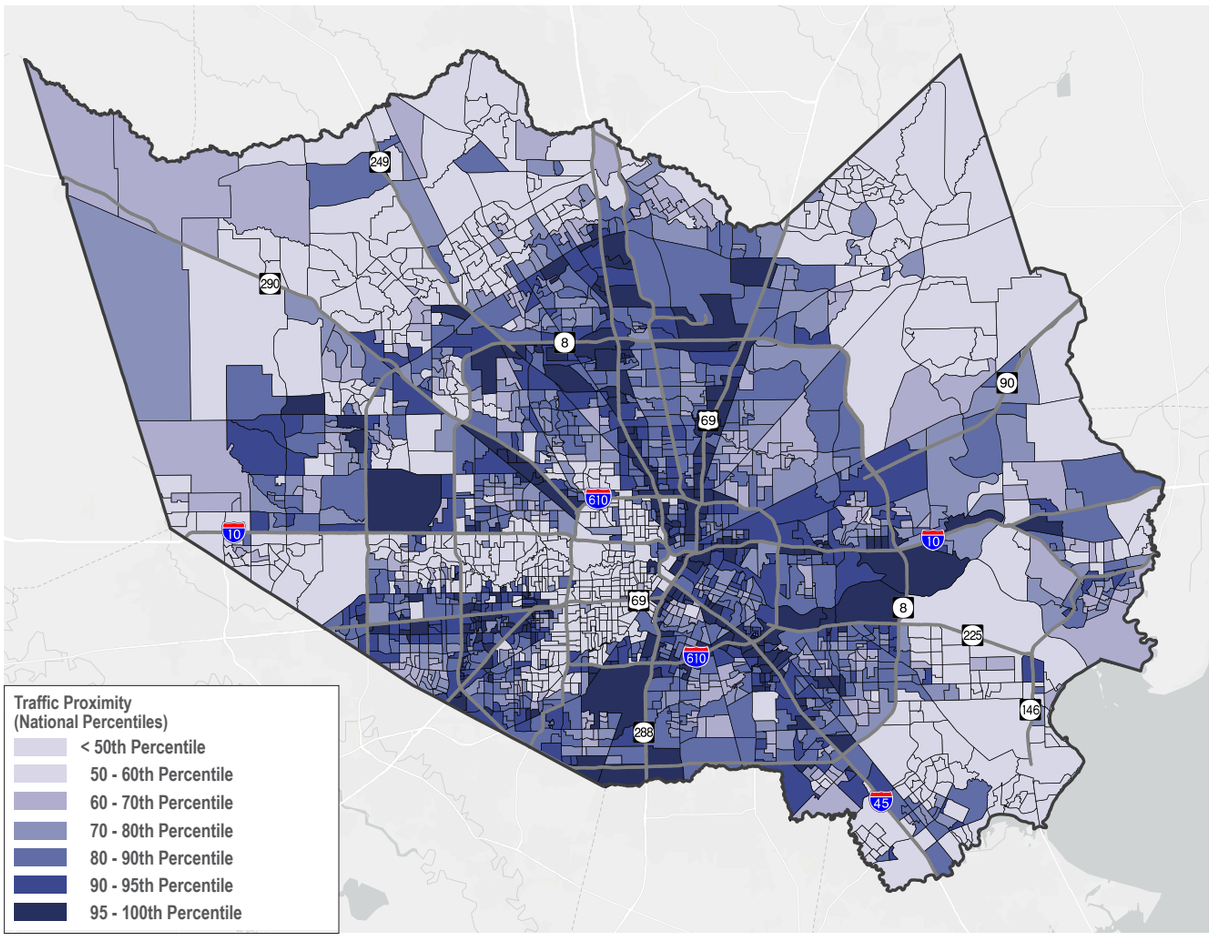


Figure 2.26 Traffic Proximity by Census Block, Harris County, TX, 2018.
Source: US Environmental Protection Agency, 2018.

"...with floods and the bacteria or mosquitoes that arise or with refineries and the air quality, it is very important to understand what's going on for us to fight what is happening and plaguing our community in the form of disease."

-Taseer Badar
Founder and CEO,
Altus Healthcare Management

Air Quality in Emergency Events

Not only does poor air quality play a role on an everyday basis, it is a common concern during emergency events involving fires.[210,211] In addition to large amounts of PM, fires involving hazardous materials may release toxic fumes. During Hurricane Harvey, for example, smoke from burning peroxides at the flooded Arkema plant in Crosby sickened police officers driving through the cloud on a public highway. They experienced eye, skin, throat and respiratory irritation resulting in scratchy throats, watering eyes, nausea, severe headaches and vomiting.[212]

Benzene, a chemical of concern during the recent large tank fire at the ITC facility in Deer Park in early 2019, can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion and unconsciousness.[213,214] Incidents involving certain extremely hazardous materials can, and have, killed large numbers of people in short amounts of time.[215,216,217] Real-time air monitoring equipment capable of detecting a wide variety of hazardous gases is essential to determining threat levels to the public and allowing preventative action to be taken. The lack of these capabilities has been identified as a significant issue by the PENTA Harris County Gap Analysis.[218] Since HCPH does not conduct air monitoring but relies on HCPCS and other partners to do so, its role during emergency events include informing the public of potential health risks, including symptoms of exposure and guidance on health measures to take, if needed. Enhanced and unified coordination and communication among monitoring agencies public health, and health care alike, is critical during an emergency.

Figure 2.27 Asthma Hospital Visits

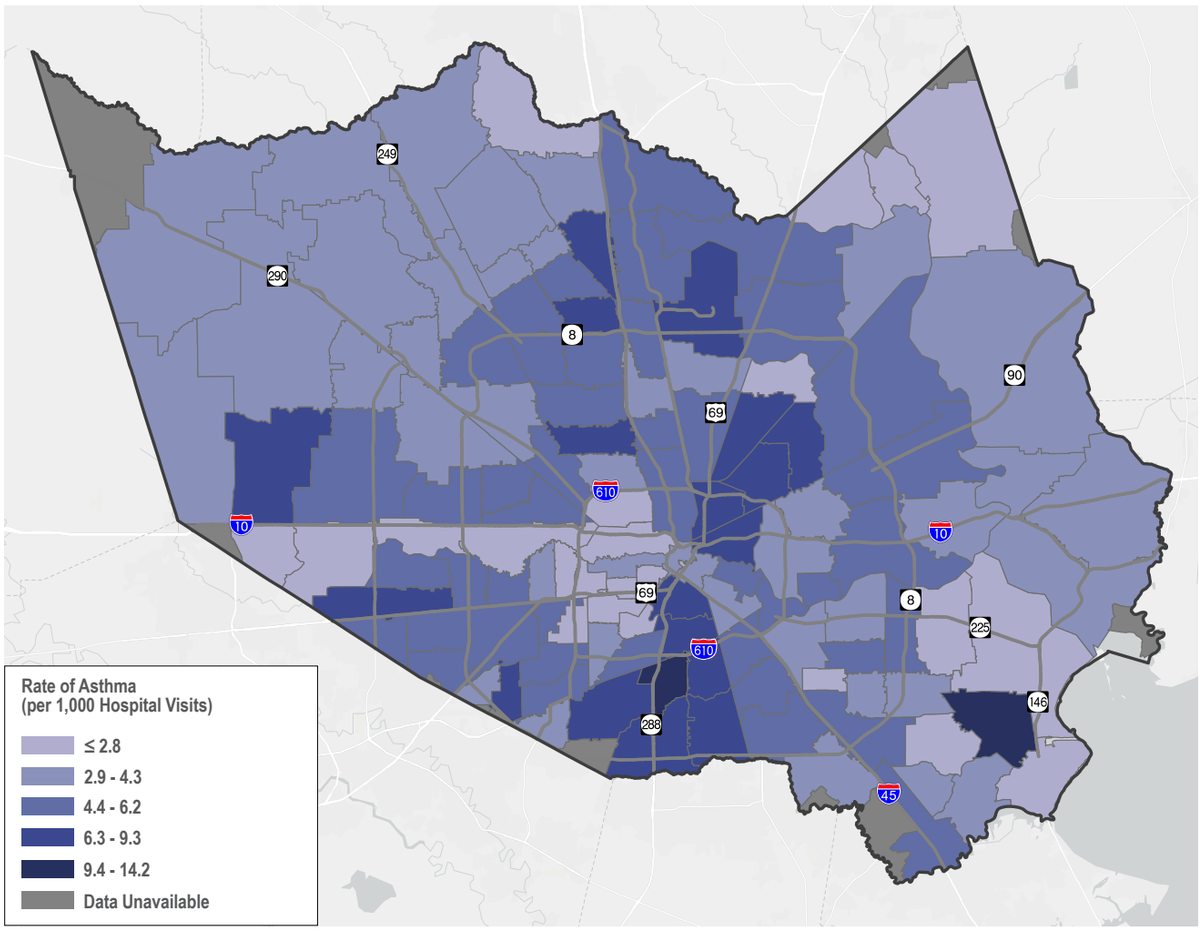


Figure 2.27 Number of Hospital Visits Due to Asthma per 1,000 Visits by Zip Code, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Water Quality

Surface Water Quality

HCPH does not conduct surface water quality monitoring or enforcement but is concerned with the effect of water quality on the health and well-being of Harris County residents. Pollutants present in Harris County waterways are a mix of waste from current facilities, nonpoint (a source of pollution not confined to a single point), source contaminants, such as fertilizers and pesticides carried into streams by rainwater and legacy pollutants that have remained in the waterways for years after they were released. HCPCS is responsible for conducting water quality testing and the TCEQ maintains annual surface water testing stations on most Harris County waterways. In general, water quality is worse in the highly urbanized western tributaries than in the bay itself, which is well mixed with the Gulf of Mexico.[219]

The Galveston Bay Foundation found upon testing the Houston Ship Channel that the most prevalent pollutant concentrations exceeding government regulations were Mercury, Dichlorodiphenyltrichloroethane (DDT), Polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyl (PCBs).[220] Many of these substances produce detrimental health effects, including cancer, damage to the nervous system and reduced cognitive ability in people exposed to them.[221,222,223] These risks are acknowledged by the TCEQ, which lists the majority of Harris County waterways as impaired,[224] and the Texas Department of State Health Services, which has had a number of fishing advisories for most of the San Jacinto River, Houston Ship Channel and Galveston Bay since 1990.[225]

Drinking Water Quality

The safety of public drinking water has received increased attention nationwide in the aftermath of events such as the 2014 Flint, Michigan, water crisis. An aging water system and infrastructure and reduced funding in water monitoring have both played a role in communities nationally.[226] Locally, public drinking water in Harris County comes from either public water systems or private wells. Public water systems that acquire their water from aquifers, lakes, rivers and reservoirs are required to treat their water prior to distribution.[227] They are also required to test their water routinely, provide Consumer Confidence Reports to their communities, and notify communities in case of violations. In 2018, 85% of Texas public water systems were in compliance with all regulations.[228] Of those who were out of compliance, the majority were due to failure to submit reports, public notices of violations, or the presence of contaminants that exceed regulations, but not at levels high enough to be considered a safety risk. Four percent of Texas public water systems had health-based standards violations, of which over 25% were due to trihalomethane (TTHM) contamination.[229] TTHM occurs when water treatment chemicals react with organic molecules in the water.

Solid Wastes: Superfund and Brownfield Sites

Superfund and Brownfield sites are areas contaminated with toxic wastes that pose a hazard to public health. Most Harris County Superfund sites are the result of illegal hazardous waste dumping in the 1950s and 1960s and underwent remediation and containment actions in the 1980s and 1990s. The EPA actively manages the remediation and monitoring of superfund sites, paid for by the various responsible parties, with reports generated every five years.[230] Remediation typically involves removal of wastes and the most highly contaminated soils along with the construction of barriers preventing the movement of, or human contact with, any remaining wastes. Cleanup efforts are vital given that they address short term (poisoning, fires, etc.) and long-term (cancers, birth defects, etc.) health effects of these hazardous areas.[231]

There are 16 EPA Superfund sites in Harris County, as seen in Figure 2.28, of which 13 are currently considered active. Remediation has been completed for all sites except the San Jacinto Waste Pits, located in the San Jacinto River under I-10, for which a remediation plan is currently under review. Brownfields are contaminated sites that the EPA does not actively manage but does provide grant funding to the landowners for their cleanup.[232] There are 102 registered Brownfield sites in Harris County, located primarily within the 610 Loop.[233]



"Four percent of Texas public water systems had health-based standards violations..."

Figure 2.28 Superfund Sites

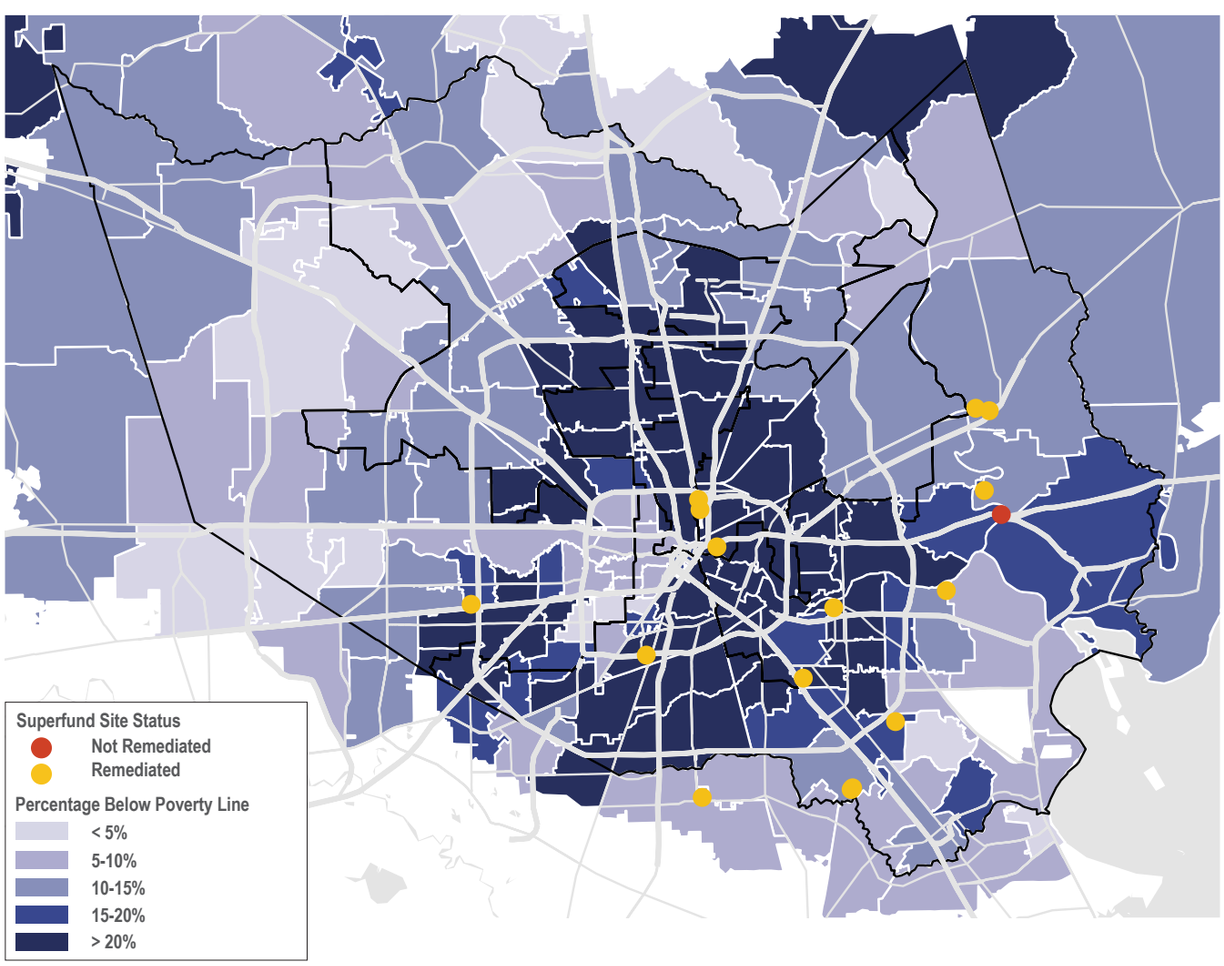


Figure 2.28 Location of Superfund Sites and the Percentage of Population Below Poverty Line Harris County, TX, 2017.
Source: US Environmental Protection Agency; American Community Survey, US Census Bureau, 2013-2017.

Climate and Health

According to the Intergovernmental Panel on Climate Change (IPCC), *climate change* refers to:

.... a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.[234]

The IPCC states that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level."[235]

Extensive research studies across multiple nations, states and regions have indicated a direct link between the warming atmosphere and the resulting changes that currently, and in the future, affect lives, livelihoods, and communities.[236] The consensus is that "the evidence of human-caused climate change is overwhelming and continues to strengthen, that the impacts of climate change are intensifying across the country, and that climate-related threats to Americans' physical, social and economic well-being are rising."[237]

> Every state in this country faces a unique combination of weather and climate events. However, Texas has encountered the most billion-dollar weather and climate disaster events over the past few decades. From 1980-2018, Texas experienced 104 total events (58 severe storms, seven floods, eight tropical cyclones, 15 droughts, seven wildfires, eight winter storms, and one freeze) with losses exceeding $1 billion, compared to 244 events across the entire United States.[238]

If these trends continue, the United States and the state of Texas should anticipate significant financial impacts. From 1900 to 2010, the Texas coastline experienced more than 85 tropical storms and hurricanes, with 12 named storms since 2000. In Galveston Bay, storm surges between 11 and 13 feet typically have return periods of 25 years.[239] Most of the state has warmed between one-half and one degree Fahrenheit in the past century, with greater warming in western Texas.[240] In eastern Texas, the average annual rainfall is increasing as rainstorms are becoming more intense and floods are becoming more severe, while the soil is becoming drier.[241] According to the EPA, sea level is already rising along the Texas coast because of climate change, and because the land is sinking due to ground water pumping. Sea level will likely rise two to five feet in the next century along much of the Texas coast as the ocean and atmosphere continue to warm, while hurricane wind speeds are likely to increase.[242]

Due to its climate, geography, industries and land use, Harris County faces environmental challenges that affect health. The humid, subtropical climate across Harris County makes it vulnerable to extreme heat effects and mosquito-borne illnesses such as West Nile Virus (WNV). The warm climate also encourages bacterial growth in area surface waters. A flat terrain, clay soil and proximity to the Gulf of Mexico place Harris County at risk for flooding and hurricanes.

The challenges are complicated by Harris County having the nation's largest concentration of oil and gas industries, chemical manufacturing and petroleum refining industries, along with mining and quarrying industries. The region's sprawling urban and suburban landscape, which encourages automobile use, has contributed to Harris County's poor air quality. The county exceeds federal standards for ground-level ozone on numerous days each year, and, for certain areas, the county has elevated concentrations of fine particulate matter.[243,244,245] Most notably, the major source of nitrogen oxides (ingredient for ozone) is mobile emissions from planes, trains, boats and automobiles.

These environmental and health care challenges may be compounded by the effects of a changing climate. Climate and health impacts are a public health concern and could have significant consequences in Harris County. Potential impacts include extreme heat, decreasing air quality, increasing occurrence and intensity of severe storms and flooding, increasing coastal hazards, and drought. Harris county's preparation and investment in resilience will ultimately determine their impact on health.

While the size and scope of climate change are beyond the scope of this report, it is undeniable that Harris County must explore its options to best protect its community. To fully assess the situation and outline the options, Harris County would benefit from a full study on climate and health and the possible government-led solutions available to it.

Built Environment: Place Matters

Environmental public health includes not only environmental impacts on health, but also how environments come together – where people live, learn, work, worship, and play. These spaces form a community and make up what is called the "built environment." Seattle - King County defines the built environment as "the human-made physical places and spaces in which people live, work, recreate, and travel on a day-to-day basis, including buildings, streets and roads, transportation systems, parks and public spaces."[247]

Health and the built environment are intricately linked because rates of chronic disease and mental health outcomes have been attributed to the design of a community.[248] These effects are felt even more among disproportionately affected populations, such as communities of color and lower socioeconomic status, who are less likely to have access to healthy food and opportunities for physical activity due to a lack of investment in community services and infrastructure.



How the built environment affects health outcomes and how changes in the environment can promote healthy living are issues that have captured public attention. Nationally, organizations and local governments are collaborating with planners and engineers to engage in the decision-making processes related to community design to address growing health challenges and inequities.[249] The built environment and community design influence behavior and health outcomes in several ways. Examples of community design promoting physical activity are the presence of shaded sidewalks, parks, and nearby grocery stores. Healthy community design links elements of planning, such as land use, transportation, housing, and parks and open space with health themes such as physical activity, the natural environment, and public safety.[250]

Healthy community design in Harris County includes:

- Opportunities to get outside and be more active
- Ability to move throughout the community without a car
- A safe community
- A cohesive community
- Accessibility for people of all ages, abilities, and income
- A clean environment
- Healthier and more affordable food choices

Communities of color and lower socioeconomic status face inequities in the quality of the built environment in which they live and work, often due to the historical lack of investment in infrastructure and services. For example, the presence and quality of sidewalks, crosswalks, and other pedestrian infrastructure is generally poorer in communities with lower socioeconomic status, thus creating barriers for active transportation and further contributing to health inequities in those neighborhoods.[251] Coupled with racial disparities in vehicle ownership among low-income populations, many communities of color are dependent on public transportation and/or active transportation to access education, employment, and community resources.[252,253] The built environment plays a significant role in the negative health outcomes of already vulnerable communities.

Policy

Policy and regulatory mechanisms play a significant role in shaping the built environment and the health of our communities. Local, state, and federal policies promoting health and safety in the built environment can create more resilient communities. Some elements that affect the built environment include building codes, street standards, and strategic planning.[254] Local and state governments can pass bonds that pay for improvements to the built environment, while the federal government regulates built environment elements, such as wastewater management and pollutants.[255] Because the built environment has a significant impact on population health and can strengthen and connect communities,[256] it is essential to look at the built environment to provide upstream, population health-directed solutions to health.

Walkable Communities

Creating and modifying the built environment to make it easier for people to bike and walk has clear health benefits for cities and their residents.[257] Research shows that more people bike and walk in communities where improvements have been made to facilitate these activities, such as adding safer sidewalks, pedestrian crossings, and protected bike lanes.[258] In addition, people tend to spend less time in their cars and more time walking when they move to communities that are designed to promote physical activity.[259] Having walkable and bikeable communities not only helps increase physical activity, but can improve communities by facilitating non-motorized transport, reducing traffic congestion, air pollution and improving traffic safety.[260]

Improving conditions to promote physical activity has clear benefits for community health and quality of life. According to CDC, over two-thirds of adults in the United States are overweight or obese and nearly half do not meet the guidelines for aerobic physical activity.[261,262] This puts them at greater risk of developing a range of health conditions such as heart disease, diabetes, stroke, and obesity.[263] For adults that have the option, walking or biking to work is one way to increase physical activity.[264] Studies have shown that using these forms of active transportation helps employees perform better at work and miss fewer workdays.[265]

Additionally, children who walk or bike to school are more physically active overall than children who are driven.[266] However, trips to school by active transportation have decreased in recent years, likely due to safety concerns. According to CDC, community programs like Safe Routes to Schools -- an approach that promotes walking and bicycling to school through infrastructure improvements, enforcement, tools, safety education, and incentives to encourage walking and bicycling) can help alleviate these concerns. Implementation of such programs have shown marked reductions in pedestrian injury of school-aged children.[267]

> As part of the Pasadena Safe Routes to School efforts, HCPH conducted a walk audit around an elementary school and assessed the condition of a pedestrian bridge over the bayou that connects the neighborhood to the school. The audit found the bridge in poor condition with rotting floorboards and holes on the mesh wire siding. The findings were shared with the school administration and then the Planning Department for the City of Pasadena, upon discovering that the bridge was not located on school property. The City was able to find out that structures built over the bayous were maintained by Harris County Flood Control (HCFC) and reached out to them to share the findings. HCFC removed the old bridge removed and a installed a new one. The new bridge, made of concrete flooring and steel siding, was installed within 6 months of the audit. The children of Gardens Elementary in Pasadena, TX now truly have a “safe route to school.”

Active transportation can go beyond promoting an active lifestyle by providing stress relief and improve upon other mental health-related aspects of well-being. Walking, biking, and staying active can boost mood and serve as a distraction from daily stressors.[268] As people decide to walk or bike instead of driving, greenhouse gas emissions decrease, and air quality improves. Improved air quality has a positive impact on the environment and the people who live in it.[269]

A challenge facing Harris County, like many communities across the United States seeking to improve walking and biking access, is that the US is a predominantly motor vehicle dependent culture. Fifty-seven percent of the households in Harris County own two or more vehicles and in Houston, the average driver's one-way commute time was 28.1 minutes in 2012-14.[270,271] So while creating safe, active transportation has many benefits, the focus in many growing communities, like Harris County, has been to develop infrastructure that supports ease of motor vehicle travel. To reverse this trend and promote physical activity at the population level, street networks and infrastructure should be designed to promote walking and biking.[272] Common pedestrian and bike infrastructure includes bike lanes, curb extensions, lighting, sidewalks, shared lane markings, high visibility signage and designated crosswalks.[273] The presence of these elements has been shown to increase walking and biking, lowering an individual's risk of being obese or overweight, while reducing vehicle use over time.[274,275] These changes have the potential to influence our health and overall quality of life.

Harris County, for several reasons, has invested heavily in car-based transit over the decades. The historical decisions that led to this have had profound health impacts. A US study found that every extra hour spent in a car per day is associated with a 6% increased risk of being obese.[276] Higher driving rates also lead to more traffic-related emissions, which contribute to poorer air quality. This has various health consequences, such as increased risk of asthma, coronary heart diseases, and cancer.[277] Fast speeds, heavy car volumes, and unsafe pedestrian crossings result in higher rates of traffic crashes, injury, and death.[278] Across the country, pedestrian deaths increased by 27% from 2007-2016, with Texas ranking 9th highest with a pedestrian fatality rate of 2.44 per 100,000 in 2016. Locally, Harris County was the 3rd highest county in the number of pedestrian fatalities with 128 pedestrian deaths, just behind Maricopa and Los Angeles counties.[279]

The Federal Highway Administration has identified Texas and the City of Houston as focus areas to improve pedestrian safety.[280] Additionally, there have been local efforts to improve pedestrian and bicyclist safety, including the Houston Bike Plan and Bayou Greenways Plan. To reduce the number of vehicle related accidents, communities can add pedestrian-friendly safety features to streets.[281] For example, the addition of sidewalks or a separated bike lane; streets with no separated pedestrian walkway or a bicycle lane and high vehicular volume are uncomfortable and unsafe for walking and bicycling.[282] Narrowed travel vehicle lanes with bike lanes and sidewalks have the potential to reduce the speed of the cars and improve travel safety for all.[283] The topic of pedestrian and bicycle safety will be explored further in the next section.

Health equity should also be considered when looking at this issue and when proposing infrastructure improvements. Individuals in low-income households are less likely to own a private vehicle and more likely to walk or bike to their destinations or to public transportation access points. However, low-income communities are more likely to lack safe and comfortable biking and walking paths compared to high-income communities.[284] A national study found that streets with sidewalks on at least one side are more common in high-income communities (89%) compared to middle-income (59%) and low-income communities (49%).[285] These conditions contribute to an increased number of traffic crashes and fatalities in low-income neighborhoods.

One way to improve the built environment to support and encourage physical activity is to incorporate mixed land use. Mixed land use considers the number of points of interest, such as schools, clinics, grocery stores, and restaurants within close proximity to the home.[286] There is sufficient scientific evidence to show that an increased mixture of destinations within close proximity to each other increases the walking and biking behavior of neighborhood residents.[287,288,289,290,291] Populations with lower incomes, such as students, older adults on a fixed income, or the unemployed may not have easy access to cars and are much more likely to walk, bike, or use transit for their daily activities.[292,293,294,295,296,297]

Infrastructure supporting active transportation has significant economic benefits as well. Studies have shown that sidewalks can increase property values. For example, since the 2008 recession, property values have exceeded pre-recession levels for walkable central business district (CBD) areas and walkable suburban areas whereas car-dependent areas have lagged behind.[298] Additionally, more companies are seeking areas with walkable spaces for their employees as local businesses benefit from increased pedestrian traffic.[299,300] Designing, engineering, and construction of walking/biking facilities creates more jobs per dollar than any other form of transportation infrastructure construction (17 jobs per $1 million spent). Overall, economies that invest in pedestrian and cyclist infrastructure benefit financially from higher property values and increase sales tax revenues while simultaneously promoting the health of the population.

Safety

Although neighborhood conditions have improved between 2010 and 2018, the built environment impacts an individual's actual safety and the perception of safety through elements of roadway design and lighting, both of which affect the use of outdoor space (Figure 2.29).[301] Data from Health of Houston, directed by UTHealth's Dr. Stephen H. Linder, can inform targeted, hyper-local interventions to improve the built environment and quality of life.[302] This will have subsequent positive health outcomes. Marked crosswalks, pedestrian-activated traffic signals, wide sidewalks, effective animal control methods, ADA compliance, and adequate street lighting create a safer environment for walking. The presence of lighting can increase pedestrian and cyclist comfort and safety and promote active transportation.[303] Additionally, improved lighting increases visibility of motorists and pedestrians in low-light conditions, leading to reductions in the number of vehicle and pedestrian crashes. According to the Governors Highway Safety Administration, most pedestrian fatalities in 2016 occurred in the dark.[304] In Texas, specifically, 80% of pedestrian fatalities between 2014-2016 occurred in the dark.[305]

> Pet ownership helps increase physical activity levels by getting people outside to walk or jog with their pet. However, outdoor activities can be hindered by stray or unleashed animals that pose a risk to community safety. The concern over stray animals to the population has been described as of particular importance to Harris County residents.[306] Animal control efforts help to decrease the number of stray animals and allow people to exercise with their pets without the fear of being attacked by strays or being chased by dogs while riding their bikes.

Figure 2.29 Adults Reporting Neighborhood Concerns (%)

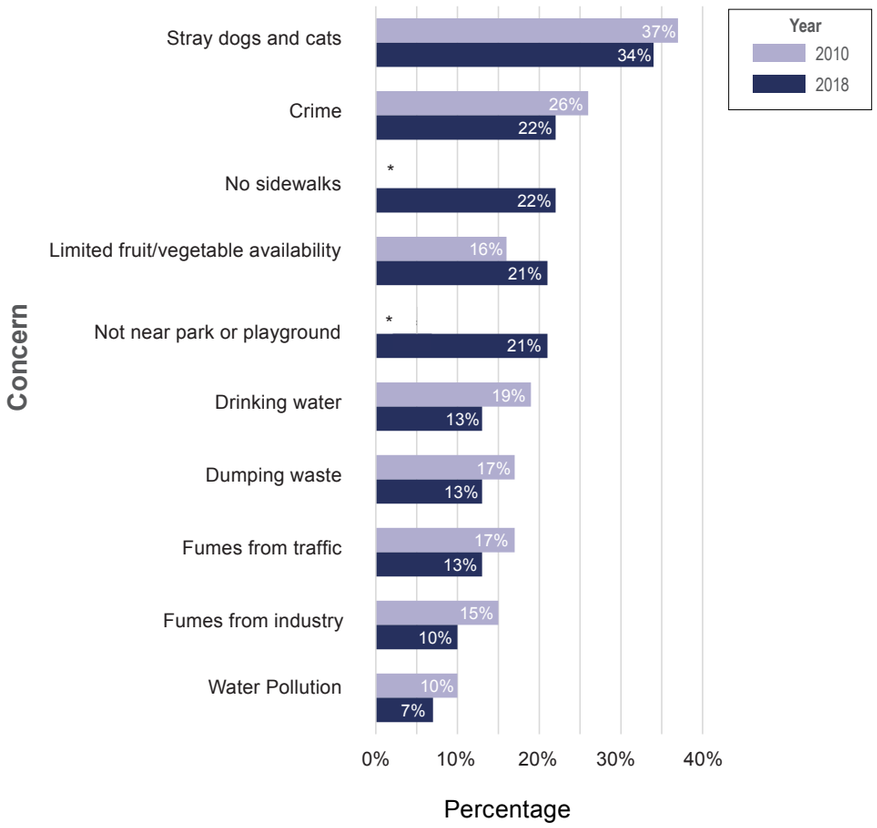


Figure 2.29 Percentage of Adults Reporting Concerns Over Neighborhood Conditions, Harris County, TX, 2010 vs. 2018.
Note: *Not measured in 2010.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Increased vehicle traffic and an increase in pedestrians are strong predictors of collisions.[307,308,309,310] However, roadway design plays an important role in shaping interactions between vehicles, pedestrians, and bicyclists along streets and at intersections. There are several proven roadway design interventions and countermeasures that have been shown to reduce pedestrian injuries through crash reduction.[311,312] The Federal Highway Administration has a resource on proven safety countermeasures for transportation agencies that enhance safety on all types of roads and that are effective in reducing the risk of pedestrian and bicycle collisions.[313]

In partnership with Healthy Living Matters, City of Pasadena, and Pasadena ISD, HCPH implemented the Pasadena Safe Routes to School (SRTS) program and plan in 2018. The SRTS program is an evidence-based intervention developed by CDC. Its purpose is to create a safe and convenient environment for children to bicycle and walk to and from school. The program promotes physical activity and pedestrian/bicyclist safety among children.[314]

In 2019, with funding from the Urban Land Institute, HCPH's Built Environment Unit developed the Safe Crossings Project to improve pedestrian and bicyclist safety in two communities within Harris County. The project identified improvements to streets and intersections that pose a risk for increased injuries in East Aldine and the City of Galena Park. The final report provides recommendations using before and after conceptual images for the communities to envision what safe active transportation could like for their residents. The goal is for East Aldine and Galena Park decision-makers to engage in conversation about bringing the conceptual vision for their communities to completion to allocate resources to implement priority recommendations.[315]

Green Infrastructure

As Harris County continues to grow, communities are looking for sustainable and effective approaches to mitigate flooding, stormwater pollution, heat, and improve air quality. Green Infrastructure can effectively address these concerns while creating a habitat and open space for recreation.

Green infrastructure is a cost-effective approach that manages the impacts of wet weather and enhances community safety and quality of life.[316] There are various positive impacts by including natural features into the built environment that are not limited to stormwater management.

Social, economic, public health and other environmental benefits are provided by Green Infrastructure techniques (Figure 2.30).[317] Elements of Green Infrastructure can be implemented into a community on many levels, from small-scale planter boxes on a site to a larger scale project involving an entire watershed.

The term Low Impact Development (LID) is used interchangeably with Green Infrastructure. Both terms describe an approach to manage and reuse stormwater to conserve and protect natural resource systems. LID focuses on project-specific solutions while considering traditional development techniques, thereby promoting benefits experienced by the developer, municipality, homeowner, and the environment.[318]As mandated by the EPA, Harris County Engineering and Harris County Flood Control District Storm Water Management Programs are required to adopt such practices. In April 2011, Harris County adopted design criteria for LID and Green Infrastructure implementation.[319] Green Infrastructure development allows for benefits at the community level, including disproportionately affected populations (low-income and minority populations) who historically have been disproportionately impacted by environmental pollution and poor built environment conditions. To ensure future Green Infrastructure plans foster equity, it is recommended to coordinate community engagement activities before plans are developed.

Health Impact Assessments

In Harris County, HCPH's Built Environment Unit uses Health Impact Assessments (HIAs) and Health Impact Reviews (HIRs) to incorporate health and health equity into the decision-making process and to inform decisions that can impact the built environment. HIA is a process that evaluates the potential health impacts of a proposed project, plan, or policy before it is approved, built, or implemented. HIAs examine social, economic and environmental influences and bring together important community members and stakeholders to help build consensus and represent the affected community.

The goal of an HIA is to inform decision-makers about the potential health impacts of a decision and provide recommendations that can increase positive health outcomes while minimizing adverse events. The process is particularly useful in non-health sector decisions, such as transportation planning and land use. The HIR is a tool used by HCPH as an expedited alternative to HIAs. HIRs are valuable tools used to provide objective and timely information to decision-makers on short and long-term public health implications of a proposed policy, program or plan. The process must be applied during the draft phase and will assess potential health impacts of proposals, policies, projects, or development plans.

In 2015, HCPH's Built Environment Unit conducted its first two HIAs. One of the HIAs was in partnership with the East Aldine Management District to inform decision-makers on the potential health impacts related to a proposed town center development in the district. As the district's first HIA, it was a call-to-action to ensure the community's quality of life, economic growth, and health were explicitly and equitably considered in its decision-making. Practices such as this help accomplish several goals:

- Develop a deep understanding of health issues from local knowledge and expert opinions
- Establish networks and pathways to better mobilize stakeholders (e.g., community-based organizations and local government) and community members around collective actions and common barriers to healthy communities
- Effect change with upstream health issues (social determinants of health) in order to impact long-term population health outcomes

Green Building

Green building is another concept that considers how a building impacts the surrounding natural environment and the people inside. It aims to create and amplify positive impacts, while simultaneously mitigating negative impacts. Green building considers energy use, water use, indoor air quality, materials, and the building's effects on a site throughout the entire planning, construction, and maintenance processes.[320]

There are several features which can make a building 'green,' including:

- Efficient use of energy, water and other resources, including renewable energy
- Reduced pollution and waste through reuse and recycling
- Maintaining good indoor air quality
- Use of non-toxic and sustainable materials
- Consideration of the natural environment in design, construction and operation
- Consideration of the quality of life of building occupants[321]

Exposure to greenhouse gases is also a growing public health concern. Population, economic activity, consumption patterns, land use, energy prices, and technology are all factors that influence the quantities of emissions released into the air.[322] What has become a common action to take in the United States is to reduce energy use in buildings through the green building approach. Green building can reduce energy use on newly constructed buildings by 25% and in existing buildings by 16% or more.[323] The approach incorporates the practice of using healthier and more resource-efficient models from building construction to demolition. The EPA identifies components of green building to include energy efficiency and renewable energy, water efficiency, environmentally preferable building materials and specifications, waste reduction, toxics reductions, indoor air quality, and smart and sustainable development (see Figure 2.31 for more details).

The Harris County Housing Program has adopted the Green Building Standard for new or rehabilitated single- or multi-family units. Under the standard, housing units should be constructed to meet the National Energy Five Star efficiency performance requirements, which includes a combination of energy efficient improvements, such as, effective insulation system and high-performance windows. Harris County requires that all affordable housing requesting federal assistance must meet the ENERGY STAR® certification as a minimum requirement.[324]

Housing

Research identifies links between housing and health, including factors in the areas of housing quality, affordability, community, and location. Living in poor housing conditions can cause or increase stress, headaches, respiratory disease and chronic disease just to name a few.[325] Figure 2.32 shows the percentage of housing units that were built prior to 1960, which captures potential exposure to lead paint. Both short-term overexposures to

Changes	Affected Population	Benefit
Provide sidewalks with minimum 5ft width along both sides of roadways	Anyone walking People with physical impairments and children	Reduces risk of pedestrian injury by 65-89% (USDOT, 2018) Improved accessibility
Install directional ADA curb ramps with a dedicated pedestrian refuge and landing space at each corner of an intersection	People with visual and physical impairments Elderly	Improves directionality for visually impaired Aligns with crosswalk
Install pedestrian-scale lighting in areas of high pedestrian traffic Install roadway lighting in between intersections	Anyone walking People with physical impairments Children	Improves pedestrian safety and prevents crime (Loukaitou-Sideris, 2006)
Incorporate a leading pedestrian interval at traffic signals	Anyone walking	Reduces pedestrian-vehicle collisions as much as 60% (Fayish & Gross, 2010)
At crosswalks, install accessible pedestrian signals and pedestrian push buttons with audible and braille features that allow people with visual and audible impairments to make use of push buttons and crosswalks	People with visual and hearing impairments	Improves accessibility for visually impaired
Install painted and visible crosswalks with continental striping	Anyone walking People with visual and physical impairments	Continental striped crosswalks are more visible to vehicular traffic Installing crosswalk reduces "fatal/ injury" crash severity by 60% Dedicated pedestrian realm will direct pedestrians to desirable crossing locations (Fitzpatrick et al, 2011)
Incorporate shade structures at bus stops	Anyone walking People with physical impairments Children	Improved protection from weather
Install elevated medians or pedestrian crossing islands at mid-block areas, multiple lane intersections, and areas of higher pedestrian traffic	Anyone walking People with visual and physical impairments	46-56% reduction in pedestrian crashes (USDOT, 2017) Improves accessibility, creates a dedicated pedestrian realm
Install dedicated bike lanes; either on-street or off-street trails Partner with local organizations to determine location and connections (e.g., Houston Bike Plan)	Bicyclists	Supports and encourages bicycling as a means of transportation Helps define road space for bikes and for cars Promotes a more orderly flow of traffic Provides an added buffer for pedestrians between sidewalks and thru traffic (important for young children walking, biking, or playing on curbside sidewalks) Has a "traffic calming" effect - roads that appear narrow result in slower vehicular speeds (USDOT, 2019; NACTO)

Table 2.3 Benefits of Green Infrastructure

Water Quality and Quantity	Water Quality	Lowers stormwater discharge volumes and also treats stormwater that is not retained.
	Flooding	Mitigates flood risk by slowing and reducing stormwater discharges.
	Water Supply	Infiltration-based practices increase the efficiency of water supply systems.
	Private and Public Cost	Results in lower capital costs for developers.
Air Quality	Ground-Level Ozone	Vegetation can reduce smog by reducing air temperatures, reducing emissions, and removing air pollutants.
	Particulate Pollution	Trees, parks, and other Green Infrastructure elements can filter and absorb particulate matter.
	Health Effects	Reduce mortality, hospital admissions, and work loss days.
Habitat and Wildlife	Habitat Improvement	Provides habitat for birds, mammals, amphibians, reptiles, and insects.
	Habitat Connectivity	Helps connect wildlife populations between habitats.
Communities	Green Jobs	Create construction and maintenance jobs.
	Health Benefits	More open space and parks encourage physical activity, reducing obesity and preventing chronic disease.
	Recreation Space	Increase publicly available recreation areas, increase opportunity for social interaction and reduce noise pollution.
	Property Value	Increased vegetation and tree cover can increase property values.

Table 2.3 EPA-Identified Benefits of Green Infrastructure.
Source: Adapted from US Environmental Protection Agency.

lead and prolonged exposure to lead can have detrimental health effects such as abdominal pain, nausea, and even feelings of depression. There is no safe level of lead.[326] Housing can also have an impact on climate change. Consider the distance between where people live, learn, work, play, and worship. Greater distances can result in longer commutes by cars, which creates more greenhouse gas emissions.

An effective approach to decrease commute time is to build affordable housing that is close to job centers or public transportation. This is critical for low-income communities whose health is disproportionately impacted due to lack of resources, access to services and living in poorly constructed and maintained housing. Low-income households also spend a greater amount of their income on energy costs compared to households with higher income. Healthy housing should be equitable for all. Regardless of income, communities should have access to housing that promotes health, mitigates risks, and reduces energy costs.

Access to Healthy Food



In Harris County... about 678,000 residents live within a food desert.

In Harris County, according to the Houston Area Food Access Map (Figure 2.33), about 678,000 residents live within a food desert. A food desert is defined as "an area where a significant number of low-income residents live more than a mile from a grocery store or supermarket."[327] A healthy diet is essential for reducing the risk of chronic diseases, such as obesity, heart disease, type 2 diabetes, hypertension, and certain types of cancers.[328] A greater density of supermarkets or grocery stores may provide better access to healthy foods if the store offers fresh, quality produce at an affordable price for its community members.[329] Studies have shown that people without supermarkets near their homes are less likely to have a healthy diet than those with more stores.[330] And, easy access to supermarket shopping is associated with a significant increase in household consumption of fruits.[331] However, some research suggests food store access by itself, as measured by proximity or density, generally has a limited impact on healthy food choices.[332,333] Additional research is needed to fully understand the impact food deserts have on the health of communities.

People choose what to eat based on a combination of considerations, such as food prices, income available to spend on food, tastes developed in early childhood or later in life, and the need for convenience.[334] Since the literature has shown many adults lack basic knowledge of daily nutrient requirements despite public education efforts, the need for complementary changes (nutrient limits, signage/menu labeling, placement, pricing strategies, etc.) to the food environment is necessary.[335,336,337,338,339,340,341] In other words, if healthy foods are not available, of poor quality, or more expensive relative to other foods, consumers are less likely to purchase them.

In order to tackle issues surrounding food access and healthy food consumption, community gardens may be one tool to improve access to fruits and vegetables, while also providing an avenue for programming and education around food production and healthy eating. Community gardens have numerous benefits that work collaboratively to influence health

Figure 2.30 Lead Paint Indicator

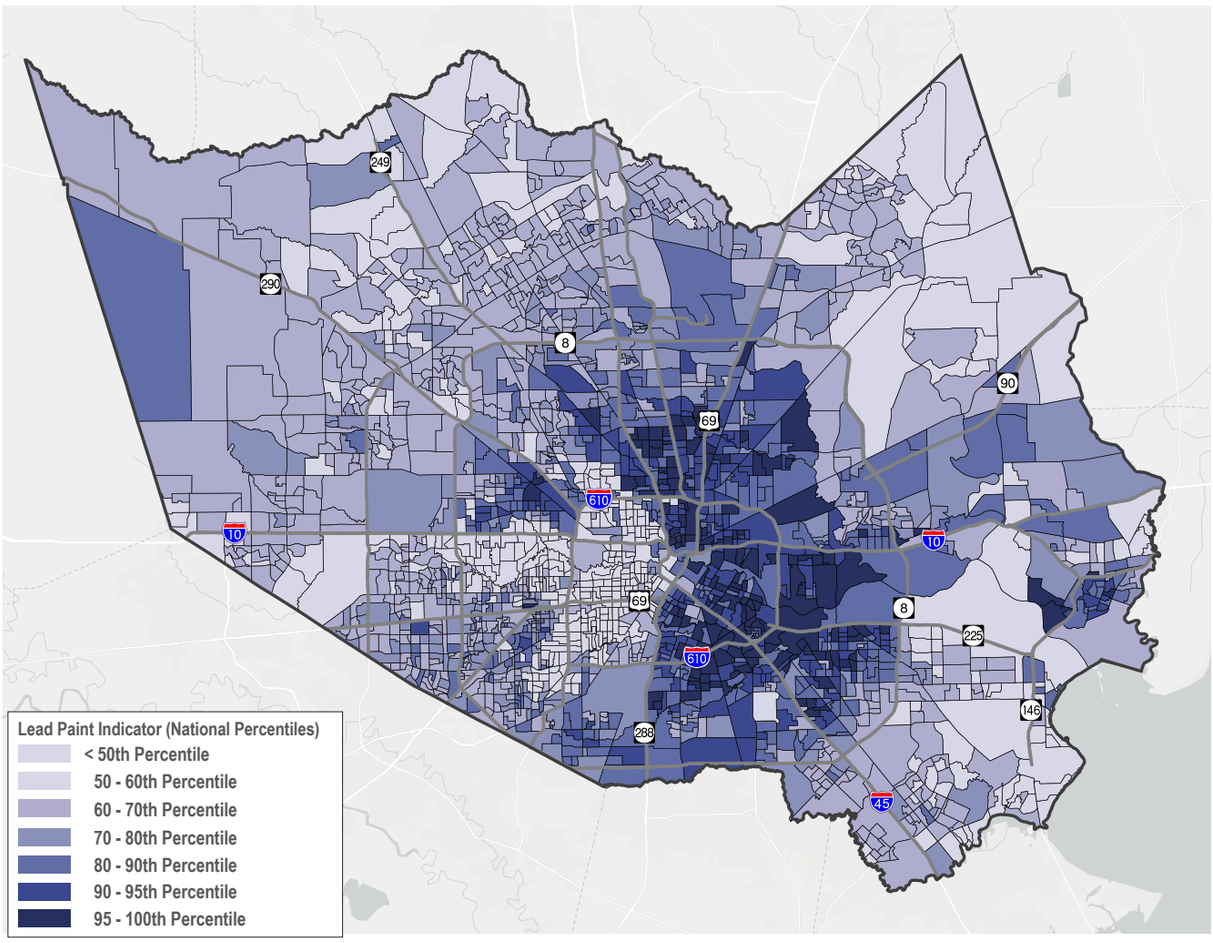


Figure 2.30 Lead Paint Indicator by Census Block, Harris County, TX, 2018.
Source: US Environmental Protection Agency, 2018.

behaviors and strengthen communities.[342] Physical benefits of community garden participation include improved food choices, increased physical activity, opportunities for education, and mental health benefits. Additionally, neighborhood gardens strengthen communities through interpersonal connections with neighbors, increasing trust among community members and developing a sense of communal empowerment.[343] Community gardens can also improve environmental awareness by promoting ecologically sustainable practices such as recycling and composting and preserving green space. Ultimately, community gardens may be one method to strengthen food security and advocate for improved accessibility to healthy, affordable foods.[344,345,346]

Access to Parks and Open Space

Well-designed parks and green space help to establish and maintain quality of life, ensuring the health of community residents, and contributing to the economic and environmental well-being of a community.[347] They have been found to improve water quality, prevent flooding, improve air quality, and provide habitats for wildlife.

Several studies have investigated the health benefits of parks and found that having a well-designed park in a community was associated with increased physical activity and mental health benefits.[348] A key link between parks and health outcomes is physical activity, which can positively influence health outcomes such as obesity, heart disease, and mental health. Despite all the research showing the health benefits of physical activity, most of the US population is not active enough. Having access to parks encourages community residents to become more active. It was found that park proximity is generally associated with increased physical activity.[349] A University of California Berkeley study found that children who lived closer to parks and recreational areas had much lower body mass index and reduced risk of obesity at age 18 compared to children who lived further away.[350]

“So I got bit by a mosquito. I put my hand in some dirty water while I was trying to make a turn. Next thing I know it is swelling up and I am heading to the hospital. The only way I could get there was because the flood waters had receded. ”

-JR Atkins, Harris County Resident, First Responder

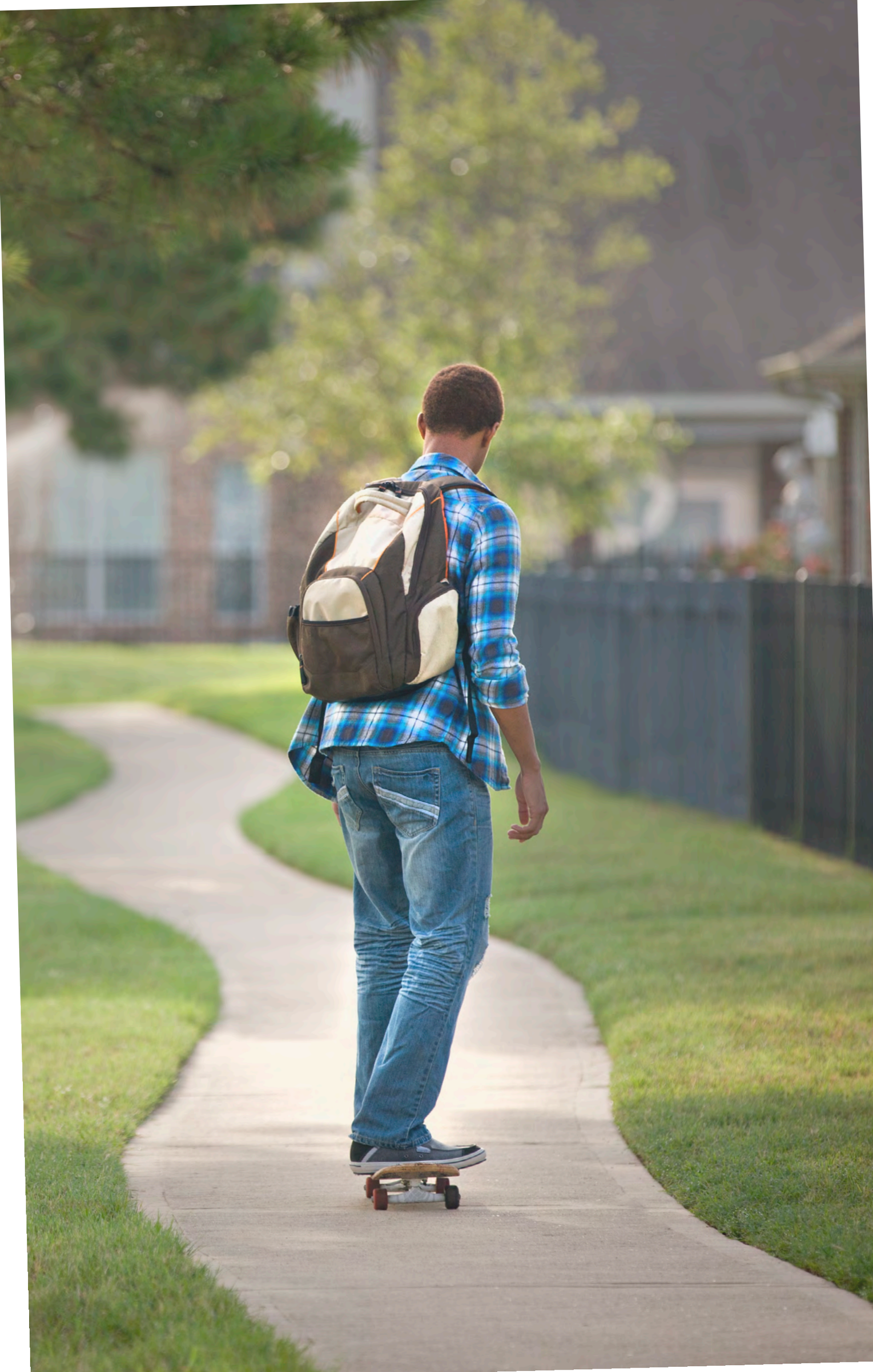
Research suggests that access to parks and green space also influences another relevant public health issue: mental health. Researchers have found that people who live more than one mile from a park or green space experience more stress than those who live within one mile of a park or green space. Also, people who visit parks more often report experiencing less stress.[351] Mental health is significantly associated with residential distance from a park. Recent research has found a significant association between mental health and number of park visits and physical activity minutes.[352]

Additional studies have found that access to parks and green spaces helps to restore the mind from the mental fatigue of work or studies and can contribute to improved work performance and satisfaction.[353,354,355] Constant interaction with green spaces and parks helps children develop cognitive, emotional, and behavioral connections to their social and biophysical environments.[356,357]

Considering the available research connecting parks with important public health issues, it’s essential for parks and recreation agencies to evaluate the availability and quality of parks in their communities.

Conclusion

The environment shapes the way we live, learn, work, worship, and play. The relationship between people and their environment, which not only includes the natural environment, but also how communities are built, is critical to creating and sustaining a healthy population. Harris County has the opportunity to make meaningful and sustainable changes for future generations of residents. Poor air and water quality, release of toxic chemicals, insufficient infrastructure for people of all ages and abilities, limited access to healthy foods, and other environmental factors, all affect health. Leveraging the built environment, by engaging public health and the community in policy, planning, and other decision-making processes, such as through the use of HIAs, can enhance opportunities to promote health, safety, and equity for all Harris County residents. Ultimately, by taking measurable steps towards reviving and developing communities with health in mind, Harris County will be able to improve both short- and long-term health behaviors and outcomes and build vibrant, healthy communities.



THE ENVIRONMENT

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 9 Recommendations

- Incorporate Health Impact Assessments or Health Impact Reviews for planned Harris County infrastructure, flood, and other projects that influence the built environment.
- Encourage Harris County to support policies and initiatives that develop and promote use of healthy, affordable, and safe options for housing, transportation, etc.
- Leverage Harris County to supplement grant dollars with additional local resources in order to address the needs of the community.
- Blend and leverage local dollars vis-à-vis with federal and state grants to widen the scope and capacity of those programs that have health impacts beyond the specific constraints of the grant to address identified community health needs.
- Initiate a robust assessment on climate and its impact on health within Harris County.
- Promote healthy and active lifestyles through initiatives such as community gardens, hike-and-bike trails, farmers markets, etc.
- Encourage communitywide health care entities to incorporate environmental health into their community health needs assessments.
- Support the development and use of sustainable Green infrastructure into new and redevelopment projects.
- Build Harris County capacity to acquire, analyze, and leverage environmental health data and its impact on human health.
- Support healthy community design initiatives such as Complete Streets, H-GAC's 2045 Active Transportation Plan, Safe Routes to Schools, and others.
- Encourage Harris County partner agencies to work in concert to improve air, soil, and water quality monitoring activities in accordance with the PENTA Gap Analysis.
- Improve coordination and engagement among agencies involved in environmental hazard mitigation that have direct or indirect impact on health.



“I love riding my bike. But it is not easy... sometimes I literally have to walk my bike or else I will get chased by stray dogs.”

- Cindy S.
Harris County Resident



"After Harvey....It took its toll. If I could go back it may sound silly, but I wish I could save my kids toys, they are so traumatized. You know Toy Story; their possessions mean a lot to them. It took 2 years for them (to be better). We had to move them house to house, move them school to school. Financially it took its toll, mentally it took its toll, a lot of people lost everything."

—Bobby T.
Harris County Resident

10

Mental and Behavioral Health

The impact of our environment plays a critical role in overall health inclusive of physical, social and emotional well-being. Mental Health is a chronic disease that affects millions of people and has various consequences on physical and emotional wellbeing. According to the WHO, over 450 million people suffer from mental health disorders.[358] Mental health is at the foundation of chronic disease prevention priorities, further underscoring the impact it has on both physical and mental wellbeing. The widespread prevalence that exists with mental illness is evidenced by the fact that more than 20% of the US population has one or more diagnosable mental health disorders in a given year.[359]

Mental health conditions primarily impacting individuals include: 29% for anxiety/depressive disorders, 25% impulse control disorders, 21% for mood disorders, and 15% for substance abuse disorders.[360,361] Mental illness is highest among women, young adults ages 18-25 years of age, and impacts all races, with a significant burden amongst American Indians/Alaskan Natives followed by Whites, Blacks and Hispanics respectively.[362] Mental health disorders lead as the top causes of disability in the United States, costing an estimated $317 billion annually, which includes treatment, lost productivity, and disability benefits.[363] As seen in Figure 2.32, several communities in Harris County experience poor mental health, which includes stress, depression and problems with emotions, for 14 or more days in the past 30 days. In Harris County, almost 20% of women said they experienced five or more days of mental health challenges within a 30-day period.[364]

Figure 2.32 Adults Who Had Poor Mental Health (%)

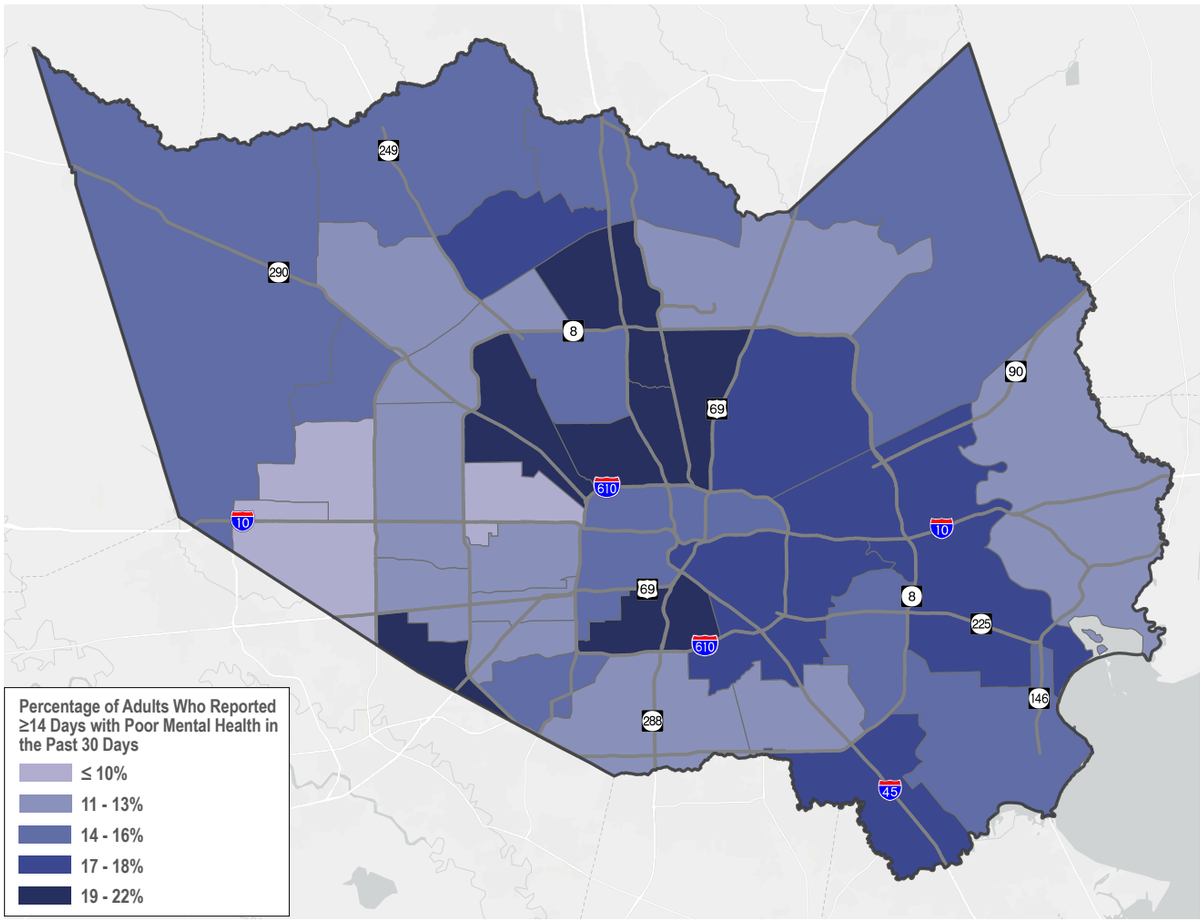


Figure 2.32 Percentage of Adults Who Had 14 or More Days with Poor Mental Health in the Past 30 Days by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Approximately 145,000 adults in Harris County have a serious mental illness such as depression, schizophrenia and bipolar and schizoaffective disorders.[365] Other factors such as income, education level, employment, disability status, insurance coverage status, race and ethnicity also play a role in the burden of mental health in Harris County. For example, approximately 71% of Hispanics, 64% of Blacks, and 55% of Whites in Harris County seriously considered attempting suicide in the past 12 months.[366] Economic circumstances also have a role in mental health, with 70% of Harris County residents who earn less than $25,000 reporting that they experienced 5+ days of mental health challenges within a 30-day period.[367] Over 20% of Harris County, residents are uninsured, with little or no access to mental health services.[368]

Mental health is a component of overall health, and often described as such: "Mental health is physical health." **Mental health should be treated in the overall context of health and wellness.** Mental health disorders require proper recognition, screening, diagnosis, and management. According to the U.S. Preventive Services Task Force (USPSTF), adults aged 18 years and older, older adults and pregnant/postpartum women should be screened for depression.[369]

Behavioral health disorders also play a major role in mental health; and are more sensitive to certain social conditions than are other disorders. There are a number of factors that predispose individuals to these health conditions, but access to quality mental and behavioral care is important to address this issue. An effort to mitigate the harm of some mental illness lies in the improvement of social conditions that shape the burden of mental disorders. Integrated multidisciplinary models that includes properly screening and identifying community members' needs by utilizing validated screening tools for undiagnosed mental health disorders are necessary tools to provide these services and have been successful across the country. Moreover, by filling the health care gap with models as such, particularly as it relates to mental health treatment, will increase the knowledge, awareness, stigma reduction, and potentially reduce the number of crisis episodes in Harris County communities.

Harris County residents with a primary diagnosis of a behavioral health condition were two times as likely to be hospitalized compared to residents with another primary diagnosis, after accounting for age, gender, race/ethnicity, payor source (insurance status), and the presence of a chronic health condition (e.g. hypertension, cardiovascular disease, diabetes or other chronic conditions).[370] This points to the fact that mental or behavioral health conditions have an impact on other diseases, either making them harder to manage or leading to more serious adverse health outcomes.

As can be seen in Figure 2.33, mental health hospitalizations have increased throughout Harris County over the last five years. This figure shows that poor mental health is a near-universal issue within Harris County, and that the number of mental health facilities may be insufficient.

Figure 2.33 Mental Health Hospitalizations

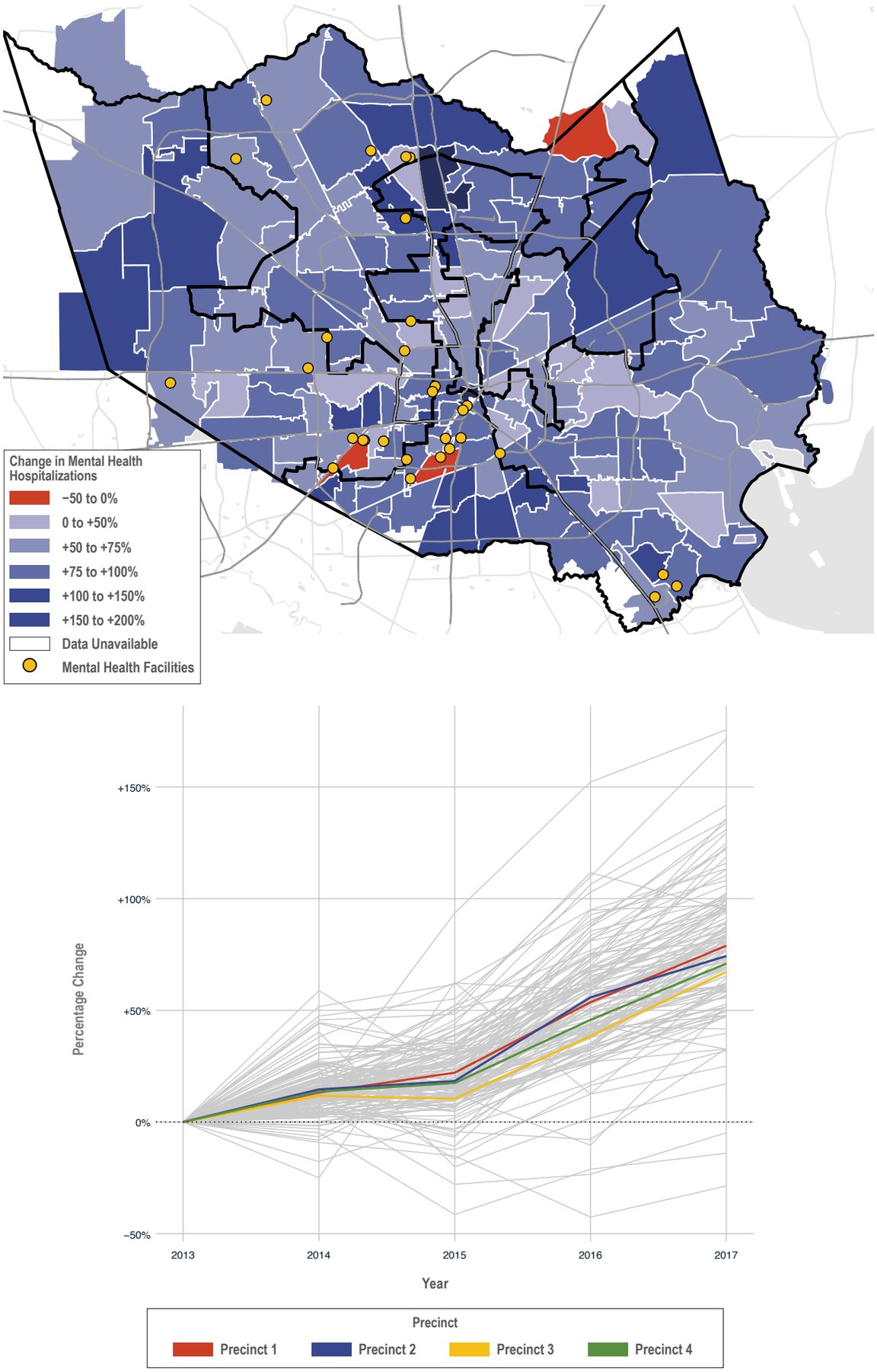


Figure 2.33 Change in Percentage of Mental Health Hospitalizations by Zip Code, Harris County, TX, 2013 vs. 2017.
Note: Each line represnts a zip code.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017; Substance Abuse and Mental Health Services Administration, US Department of Health and Human Services.



Addressing both physical health and mental health is an effective approach for ensuring that appropriate screening for mental illnesses occur. Health care settings with an integrated model seek to address the importance of both mental illness and traditional acute or chronic disease. Chronic diseases that affect an individual's physical health such as diabetes, hypertension, and heart disease are best treated in the early stages. Mental illnesses have a much earlier onset than many other chronic diseases such as heart disease or diabetes. In fact, mental illness that starts at an earlier age has the potential to be more debilitating over the duration of a life. Projections estimate that by the year 2020, neuropsychiatric conditions will account for 15% of disability worldwide.[371] Individuals living with serious mental illness have increased morbidity and mortality compared to individuals without a serious mental illness.

Behavioral health disorders are more sensitive to certain social conditions than are other health disorders. One such issue is the growing concern of substance abuse and misuse that has impacted millions of Americans. Recent attention has been placed on the growing opioid epidemic as it affects our nation. The rampant, addictive nature of both heroine and prescription pain medications, such as oxycodone, hydrocodone, and fentanyl has resulted in a call to action from the federal government deeming the issue as a Public Health Emergency in October 2017. Drug overdose is the leading cause of accidental death in Harris County and across the United States. Drug abuse also contributes to other leading causes of injury and death, such as violence, car crashes, and self-harm. Over 50% of those deaths are related to prescription drug abuse, including opioids.

In 2017, national data revealed that opioid overdose fatalities were continuing to climb to a national average of 21.7 deaths per 100,000, claiming the lives of more than 70,200 Americans. The sharpest increase occurring among deaths related to fentanyl and other synthetic narcotics.[372] In Texas, the opioid overdose rate during that year was 5.1 deaths per 100,000 (1,458 individuals).[373] The current drug overdose mortality rate in Harris County is 12.1 - 14.0 deaths per 100,000, slightly below the national average of 14.7 deaths per 100,000.

Across the nation, suicides are a growing concern as the rate continues to rise overall with an average of 129 suicides/day. In fact, the suicide rate in 2017 was 33% higher than in 1999. The rates among individuals between the ages of 15 to 64 increased from 10.5 deaths per 100,000 in 1999 to 14 deaths per 100,000 in 2017. The rates of suicides are highest among middle-age white males, who accounted for 69.67% of suicide deaths in 2017. [374]

In Texas, the suicide mortality rate is 13.4 deaths per 100,000 residents, which is slightly lower than the national average (14.0 deaths per 100,000). According to CDC, in Harris County, the suicide rate is 10.8 deaths per 100,000 which is lower than the state and national rates. Data shows that death from self-inflicted injury/suicide is affecting three times the number of males than female, Whites, and persons ages 18 - 44.[375]

"Approximately 145,000 adults in Harris County have a serious mental illness..."

Access to Mental Health and Behavioral Health Care Services

The current mental health care system is comprised of government, nonprofit and for-profit agencies. Within Harris County there are approximately 206 facilities that provide mental and/or behavioral health services. These facilities include community health centers, FQHCs, safety-net clinics, school-based health centers and the Veterans Administration Hospital System (VA Hospital System). The public mental health care system within Harris County consists of the Harris Center, the Harris County Jail, Harris Health, and Harris County Psychiatric Center. Given the burden and prevalence of mental illness across the county, an opportunity exists to increase mental health care capacity particularly in communities where there is no existing infrastructure.

A number of community health clinics and safety net clinics have integrated mental and behavioral health models. These models typically include embedding a validated mental health screening tool into existing workflows and if positive, a mental and behavioral health provider (e.g., Licensed Practical Counselor, Clinical/Medical Social Worker, Chemical Dependency Counselor) who is part of the clinical team can offer immediate point-of-care counseling that can occur at the same time as other health care needs are being addressed.[376] Some clinical models that do not have co-located mental health providers can utilize case managers and/or navigators to further link patients to care.[377] Integrated primary health care settings also offer opportunities for mental health screenings and management. These models create opportunity to screen, manage and offer services to more individuals. Innovative models that integrate tele-mental health services can also offer opportunities for mental health services in communities that lack infrastructure or resources where inequitable systems can be a factor such as mental health provider shortages within geographical areas and transportation barriers.[378]



“There is a strong correlation between adverse childhood experiences (ACE) and risk factors for behavioral health issues...”

In Harris County, Memorial Hermann Hospital System, Vecino Health Centers, Harris Health, and Legacy Clinic serve as the largest provider of school-based clinical care. School-based clinics are uniquely poised as primary medical homes for children with limited access to health care including mental health care. Integrated school health models, such as Lemon Grove School District located in San Diego County, are utilized in other large metropolitan areas and have been successful when approaching comprehensive health care that is available to an entire community (e.g., pediatric, adolescent, adult and senior health care services) particularly in health and mental health resource-limited areas.

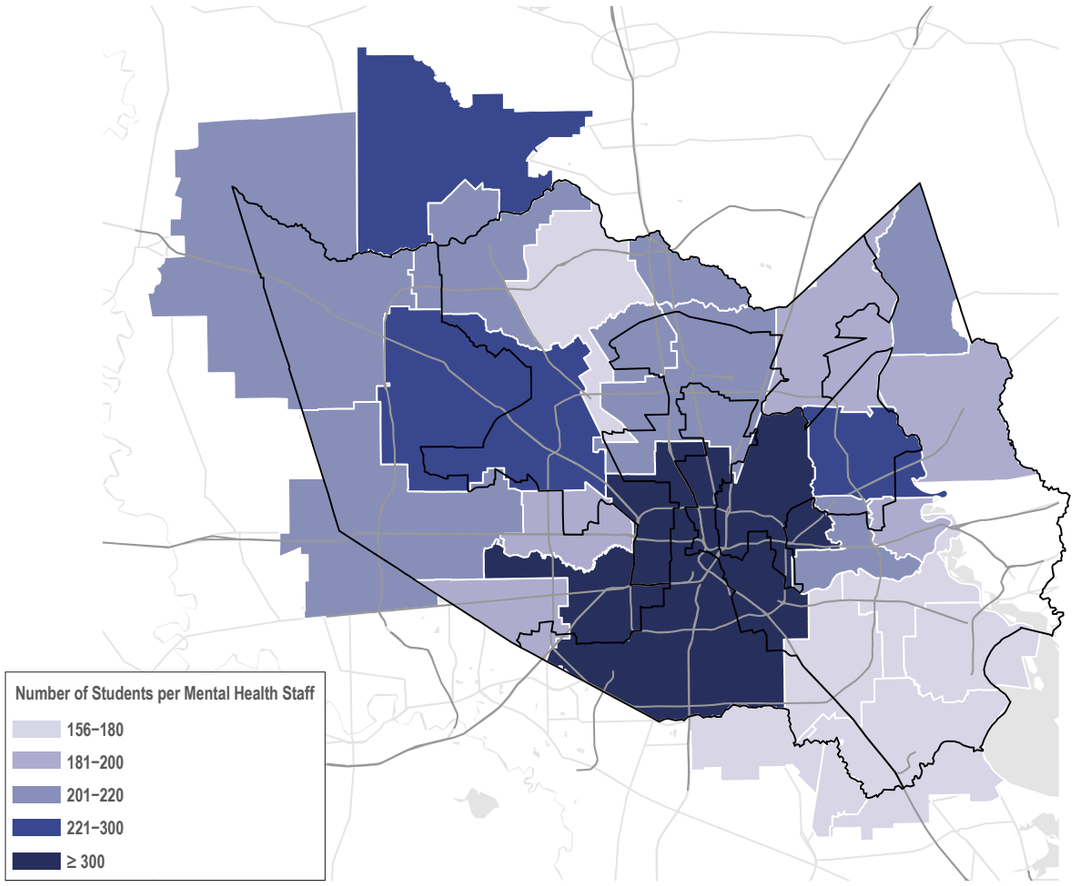
In settings where school-based clinics are not integrated, Harris County ISDs employ counselors, nurses, case managers to address the social and emotional needs of students, as depicted in Figure 2.34. Opportunities to adopt or implement school-based clinics or family wellness clinics utilizing school-based platforms could potentially be considered in areas within the county where services are sparse. Community-based organizations such as ProUnitas, Communities in Schools, and Community Youth Services that serve as community resources by collaborating with school districts to offer support and services focusing on social and emotional well-being for students and families that further empower them to thrive and succeed.[379]

Mental Health Facilities

Historically, there has been, and continues to be, a shortage of mental health providers in Harris County and as the population increases this shortage will worsen. Moreover, as shown in Figures 2.37 and 2.38, mental health facilities and substance abuse treatment facilities tend to be clustered in areas transitioning from lower social vulnerability to higher. There are large swaths of communities with higher levels of social vulnerability who lack a mental health facility.

The largest mental health facility in the state of Texas is the Harris County Jail. The Harris County Sheriff’s Office (HCSO) maintains the care, custody, and control of all patient-inmates in the facility, which has an average daily census of greater than 9,000 and yearly intake bookings exceeding 130,000 adults. Of those bookings in 2016, approximately, 3,100 suffered from some form of alcohol or opiate-related substance use disorder (2,278 suffered from opiate use disorders and 829 suffered from alcohol use disorders).

Figure 2.34 Mental Health Staff in School Districts



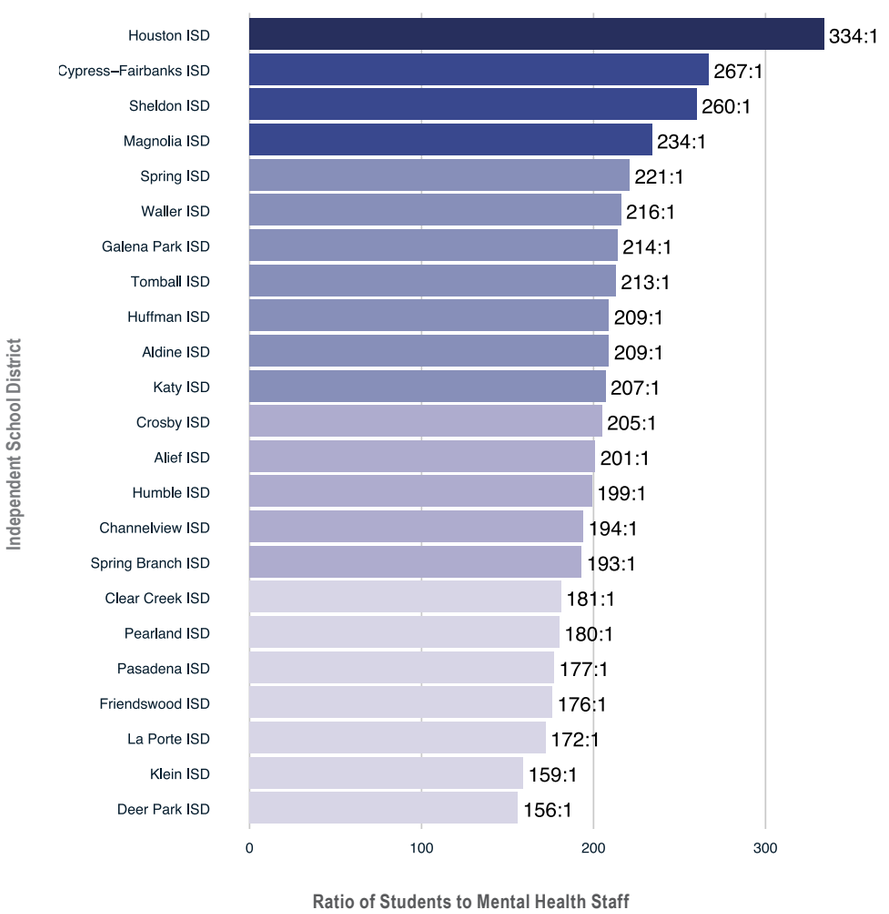


Figure 2.34 Number of Students per Mental Health Staff by Independent School District, Harris County, TX, 2017-2018.
Source: Texas Education Agency, 2017-2018.

HCSO Health Services affords these patient-inmates with near comprehensive, in-house health care, including 24-hour medical, psychiatric, nursing, radiographic, laboratory, and counseling services. Approximately 25% of them take psychotropic medications, underscoring the burden in mental health within this special population.

The Harris County Mental Health Jail Diversion Program was initially piloted in 2015 to address the growing concern of incarcerating mentally ill residents. This program is a collaborative effort that was developed by a number of key stakeholders including the HCSO, The Harris Center, Harris County Judge's Office (HCJO) and Texas Department of State Health Services. The jail diversion program is a nationally recognized comprehensive model of mental health services for individuals with serious mental illness that encounter the criminal justice system. In 2018, HCSO made 17,000 mental health referrals for inmates processed in the jail.[380] Lengthy wait lists and wait times, ranging from 58 days to several hundred days, depending on the offense, for patient-inmates requiring transfers/hospitalization for mental health services at state facilities, such as Rusk Hospital, have been reported due to capacity and financial issues.[381]

Mental health disparities exist in Harris County for a myriad of reasons including funding challenges, increased health resource shortage areas with a paucity of mental health providers and communities that lie within unincorporated Harris County with limited access to obtain much needed services. When considering the aforementioned special populations, these individuals can often experience higher rates of arrests and incarceration, acute crisis episodes, increased emergency department utilization, and increased psychiatric hospitalization readmission rates. The Harris Center relies on three hospitals for inpatient adult care: the Harris County Psychiatric Center, Harris Health, Ben Taub Hospital, and Rusk Hospital (mainly for forensic/criminal cases).[382]

Aside from a shortage of mental health providers, navigating the affordability of the county's mental health system presents an additional barrier to accessing services. Unlike typical health care services, access to mental and behavioral care services, especially opioid treatment, is challenging even for Harris County residents, regardless of insurance coverage status. The complexity of receiving appropriate services is further complicated by the type of payment/funding accepted by an organization or provider depending on coverage status. For those who do not qualify for public mental health services, self-pay may be the only option. The publicly funded system only provides services to persons with serious mental illness who are uninsured or underinsured, lower income and persons needing voluntary or involuntary hospitalization.

The state's decision not to participate in Medicaid expansion is negatively impacting mental and behavioral services. In the 2019 State of Mental Health Rankings (a comparison of all fifty states including the District of Columbia), Texas ranks poorly in the following metrics:

- 51/51 highest number of uninsured individuals with mental illness
- 47/51 for adults with mental illness who go untreated
- 51/51 for the highest percentage of youth not receiving mental health services[383]

Adults with a serious mental illness do not qualify for Medicaid or disability unless a person cannot work or is expected to die. Undoubtedly, the decision not to expand Medicaid has had an impact on the affordability of services as residents have identified the cost of services and insurance co-pays as unfortunate barriers.

Mental health services are paid for through a mix of public or state dollars, private nonprofits, private and public insurance, and self-pay. Despite increases in state funding for mental health services, Texas still ranks in the bottom for mental health spending; as the state spends significantly less at $40.65 per capita, compared to the national average of $119 per capita. In 2011, Texas was faced with the highest number of uninsured and uncompensated care, since Medicaid expansion for the state was not approved; Texas applied for, and was awarded, Medicaid 1115 Waiver funds. These funds provided for a five-year Medicaid 1115 Waiver project, allowing the state to deliver pilot programs to improve health care outcomes and reduce costs, creating a pool of funds through DSRIP payments.[384] A number of state DSRIP funded projects are focused on mental and behavioral health. These DSRIP projects range from expansion of community and hospital-based behavioral health clinics, to expansion of crisis intervention services, integration and behavioral health services, case management/navigation, and community- and clinic-based behavioral health education. Unfortunately, funding for Medicaid 1115 Waiver projects is expected to decrease in 2020 and be eliminated in 2021. The loss of this funding is projected to have a substantial impact on the mental and behavioral health infrastructure.



"...the Hurricane Harvey Registry show nearly two-thirds of respondents experienced Harvey-related mental health difficulties..."

Figure 2.35 Mental Health Facilities and SVI

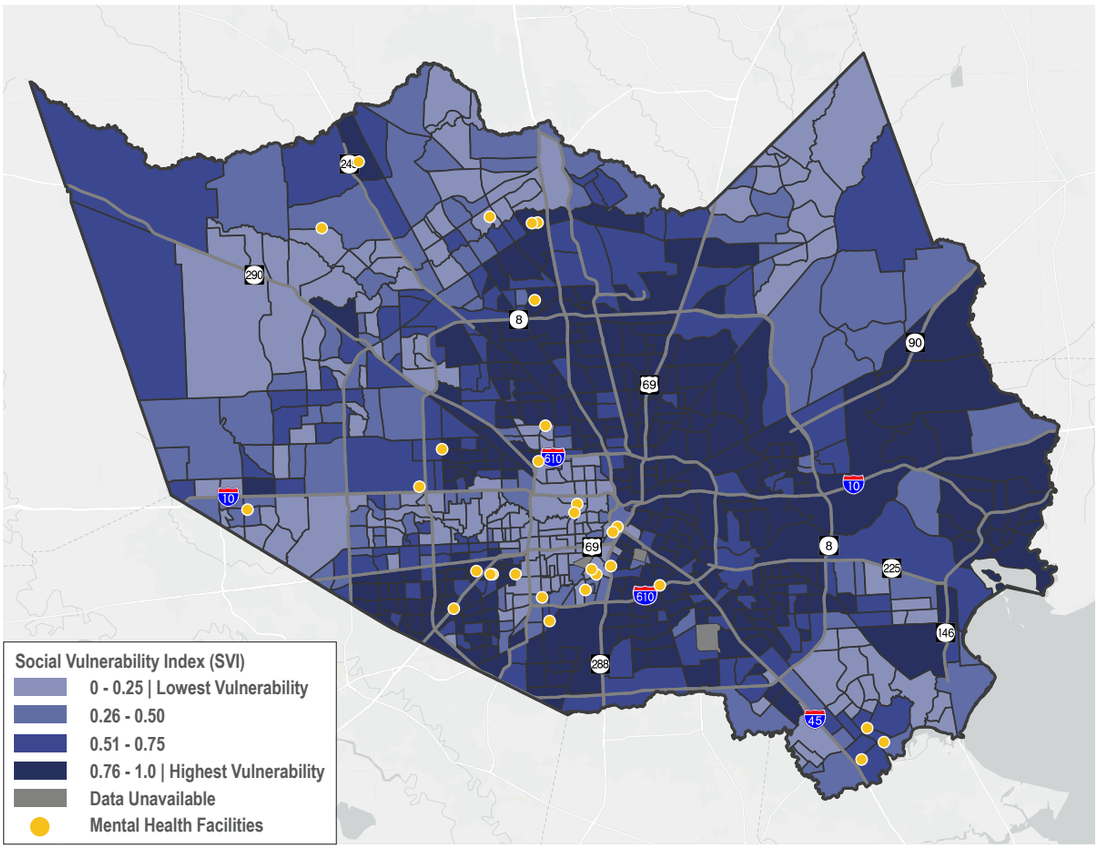


Figure 2.35 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
Source: Substance Abuse and Mental Health Services Administration, US Department of Health and Human Services; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Figure 2.36 Substance Abuse Treatment Facilities and SVI

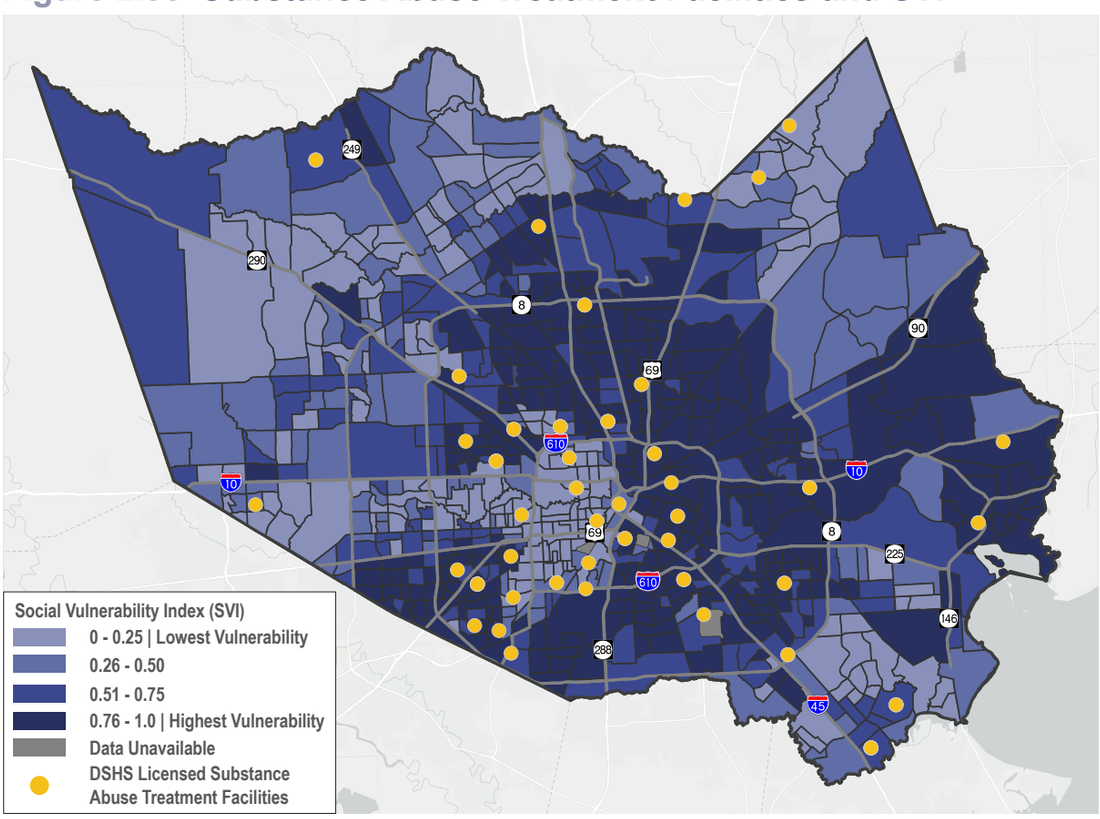


Figure 2.36 Substance Abuse Treatment Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
Source: Health and Human Services Commission, Texas Department of State Health Services, 2019; Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, 2016.

Social and Environmental Factors

Social and environmental factors play a large role in acceptability and accessibility of comprehensive treatment for mental illnesses. **Certain populations have higher rates of behavioral health issues** as evident through available data and community voices. These special populations, including incarcerated youth and adults, lesbian, gay, bisexual, transgender, queer (LGBTQ) residents, immigrants and veterans, are at greater risk due to social inequities that influence their health including poverty, unsafe neighborhoods, poor housing conditions or homelessness, lower education, unemployment, and discrimination. In Harris County, among those with mental illness, significant inequities exist. For instance, adults with serious mental illness typically have lower levels of educational attainment, higher rates of unemployment, and higher rates of housing insecurity.[385] Comprehensive case management and "wrap around" support services, such as housing and employment assistance, are crucial components that are needed to effectively treat those living with mental illness.[386]

Spirituality and Faith

The role of spirituality and faith in a community such as Harris County cannot be underscored enough. Faith-based constructs for addressing health and wellbeing beyond mental and behavioral health are key to "wellness" when residents are asked about how they get through their day or how they see the world. Whether it is due to everyday issues, urgent matters that come up, conflict resolution, or large-scale disasters, faith is of high importance to most Harris County residents. Addressing spirituality – while not subject to any one faith, religion, or even to those who do not ascribe to any religion whatsoever – is increasingly important for health-related agencies to be cognizant of, design programming for, and simply understand the interconnectedness as it relates to health outcomes. While such a topic has many important considerations in viewing how it impacts health – including related to end-of-life issues such as palliative care or when a loved one is admitted to ICU setting, etc. – that are beyond the scope of this study, **the role of the faith community as partners and key stakeholders is critical** to the success not just of any specific health initiative but also in helping articulate the importance of "health" to the overall community's well-being moving forward.

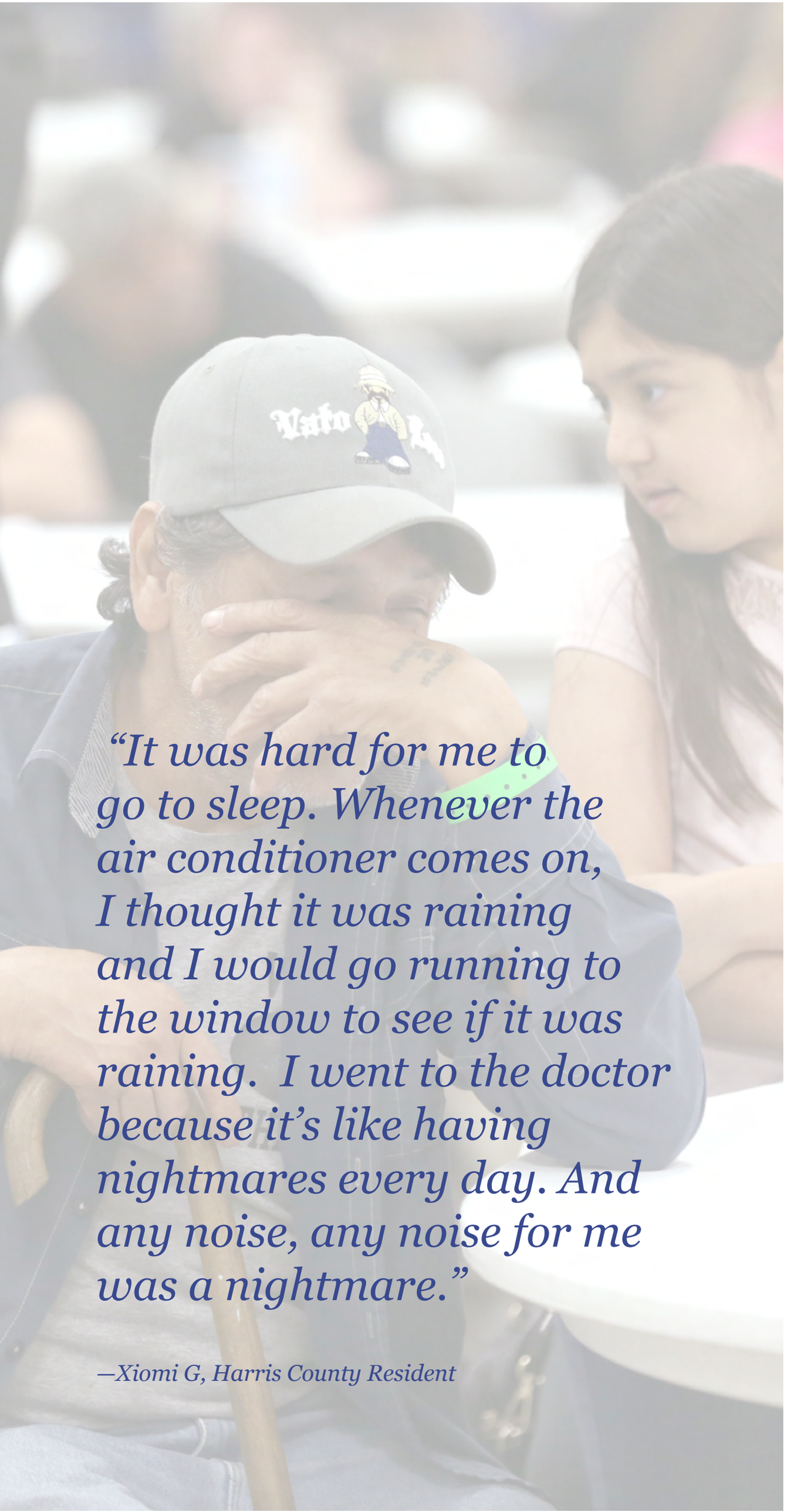
Mental Health Benefits of Owning a Pet

Social relationships and community connectivity are becoming increasingly important in a person's management of their mental health condition. There is indication that owning a pet can play a role in this regard. This comes from a body of evidence showing that pet ownership can reduce stress, promote social and community interaction, and improve overall quality of life. [387,388,389] Numerous studies have shown that overall, pets provide benefits to those with a mental health condition. One of the main themes was related to pets providing emotional comfort and mitigating against feelings of isolation and loneliness.[390]

Resilience

Repetitive and recurrent exposure to stressful environmental events without proper support systems/structures in place is known as "toxic stress." Particularly for youth exposure to "toxic stress," it can result in long-term behavioral and general health problems. There is a strong correlation between adverse childhood experiences (ACE) and risk factors for behavioral health issues and the development of adult depression is strongly linked to the occurrence of emotional, sexual and physical child abuse.[391] Anxiety disorders are strongly linked to sexual child abuse and family abuse. Poverty and differences in race, ethnicity, or language; parental education and employment level, increases the risk of adverse physical and mental health outcomes.[392]

Resilience is an important factor in a person's worth with respect to both physical and mental health. This is especially the case in disaster recovery. After a natural disaster, it is normal for survivors to experience stress, fear, sadness, and anxiety. The loss of a job, home, family members, and a sense of normalcy can lead to more serious mental health problems such as depression and post-traumatic stress disorder. Initial findings from the *Hurricane Harvey Registry* show nearly two-thirds of respondents experienced Harvey-related mental health difficulties, particularly symptoms of post-traumatic stress.[393] Other adverse behaviors such as substance use and domestic violence can increase in the months following disasters.



"It was hard for me to go to sleep. Whenever the air conditioner comes on, I thought it was raining and I would go running to the window to see if it was raining. I went to the doctor because it's like having nightmares every day. And any noise, any noise for me was a nightmare."

—Xiomi G, Harris County Resident

Resilience and mental health are intrinsically linked. Individuals who have the skills and tools to cope with, and recover from, the trauma and aftermath associated with disasters, are better situated to deal with the long-term effects of disasters as well as to recover mentally and physically from these events. Promoting social cohesion is the foundation for resilience, in that the communities that have stronger ties among individuals have been shown to recover more quickly from disasters. Individuals with stronger interpersonal networks have also been shown to recover more efficiently from disasters. By promoting connections and cooperation, we are promoting mental health as well as resilience.

Conclusion

In summary, many reports and studies show that Harris County has experienced a shortage of mental health providers over the years. Systems-level approaches are required to mitigate the impact of these continual shortages and have seen success through other collective impact approaches such as BridgeUp with the Menninger Clinic.[394] One major success in this area has been the Jail Diversion program which, since 2015, has helped individuals with mental illnesses get diverted from the criminal justice system. However, more must be done to help alleviate the burden of mental health illness on EDs. Increased communication, coordination, and collaboration among Harris Health, HCPH, Harris Center, and other key partners, can shorten the timespan between a resident developing a mental health illness and receiving the necessary treatment. Because many issues can start early, building on existing partnerships with area independent school districts and investing in mental health staff within those school districts would pay dividends in the long run.

Mental health is important to everyone; it is not separate and distinct from physical health, in fact, poor mental health can adversely affect a person's ability to maintain good physical health or engage in health promoting behaviors.[395] Fortunately, through early interventions such as mental health screening during primary care visits, integrated mental and behavioral health models, and timely access to mental health resources within school- or community-based health settings, it is a treatable and manageable chronic disease.

Individuals living with a mental health disorder can lead healthy and productive lives when provided with the appropriate care and resources. In Harris County, various agencies including HCPH are working together to improve the mental health system by focusing on the root causes that can contribute to poor mental health or inadequate treatment and management of mental and behavioral health conditions. As evidenced by the data, there is capacity for infrastructural facilities, programs and interventions to meet the needs of our community, particularly from a mental health perspective. In summary, a goal for improving the health and well-being of Harris County involves equitable access to health at all levels inclusive of physical, physical, behavioral, social, environmental, and mental health.

Los Angeles County Department of Mental Health – Underserved Cultural Communities (UsCC)

A cornerstone of the Los Angeles County Department of Mental Health (LACDMH), the UsCC empowers underrepresented ethnic/cultural groups to participate in the decision-making process for mental health services. The UsCC subcommittee works closely with community partners and consumers to increase the capacity of the public mental health system and develop culturally competent recovery-oriented policies and services specific to the UsCC communities.396 The Eastern European/Middle Eastern UsCC subcommittee recommended the development of a mental health talk show in the Armenian language to reduce stigma and increase awareness about the signs and symptoms of mental illness. This project resulted in a 500% increase in calls from Armenian community members to the LACDMH Access Line to seek service and information.[397]



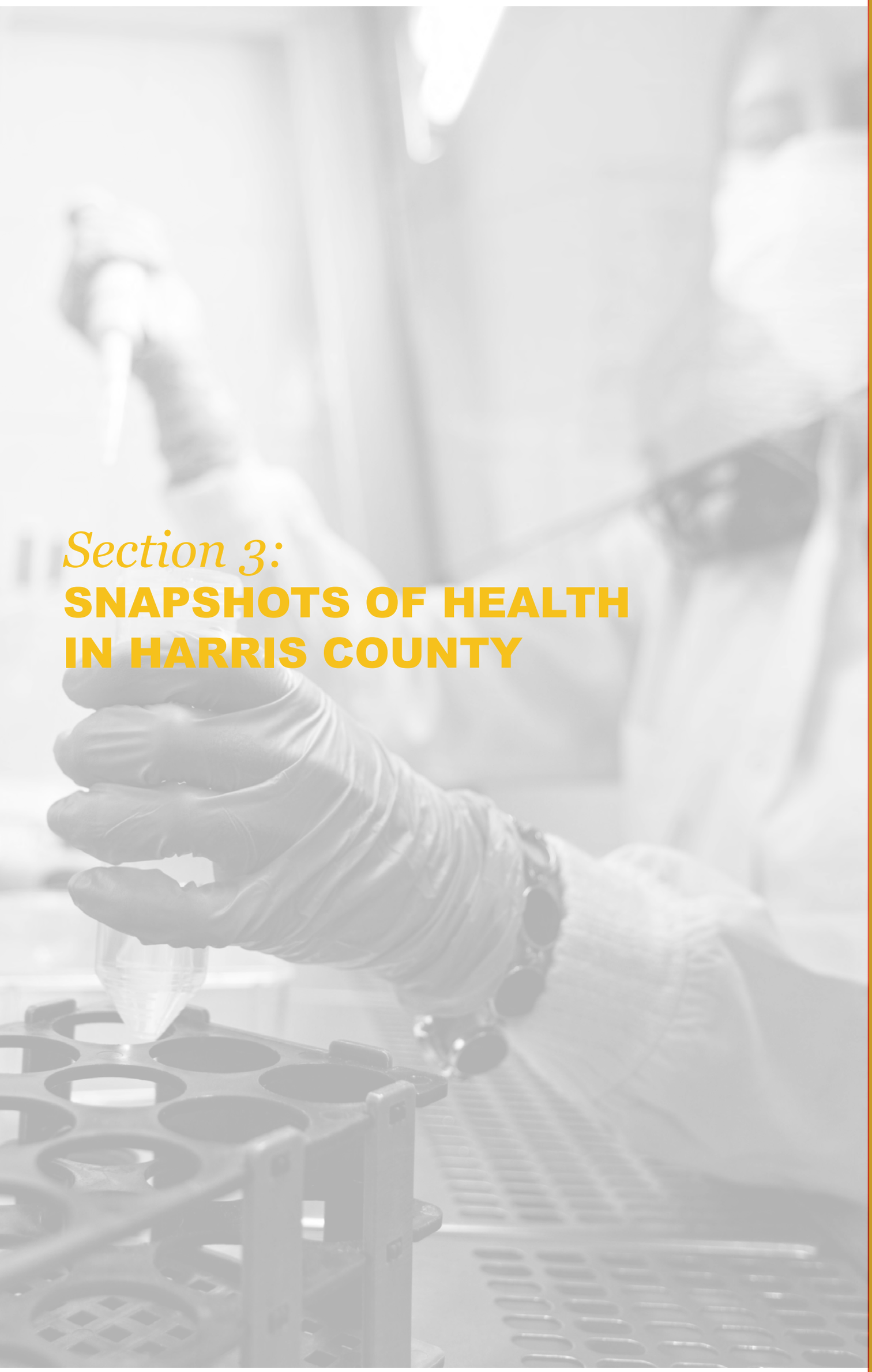


MENTAL & BEHAVIORAL HEALTH

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 10 Recommendations

- Support Harris County initiatives to reduce stigma and improve the awareness of mental health concerns, available resources, and potential referral options.
- Support policies that incorporate routine mental health screening into integrated primary health care settings.
- Encourage the development and sustainability of community collaboratives and social networks that support individuals with mental health and substance abuse issues.
- Advocate for additional state and federal funding and resources that increase the capability and capacity of the mental health system in Harris County.
- Supplement state and federal funding and resources for the mental health system in Harris County with local investments.
- Explore opportunities to invest in tele-mental health technologies and other innovative methods for service delivery for all county residents, with a particular emphasis on those who are disproportionately impacted.
- Support best practices such as the use of naloxone and medication-assisted treatment to address opioid abuse.
- Build Harris County capacity to acquire, analyze, and leverage local mental health data.
- Support initiatives within the criminal justice system that provide "wrap-around" services (housing, employment, case management, etc.) to individuals with mental health needs as they transition from incarceration to community settings.
- Integrate mental health programming into existing primary and secondary care systems across Harris County agencies.



Section 3:

SNAPSHOTS OF HEALTH IN HARRIS COUNTY

Chapter 11: Chronic Diseases

Chapter 12: Injuries

Chapter 13: Family Health

Chapter 14: Infectious Diseases





"Public health works best when leveraging work with other partners like education and law enforcement and transportation. . Asking a lot about different categorical areas, but root causes often crosses categorical lines."

—Liza Corso
Senior Public Health Advisor, Centers for Disease Control and Prevention

11

Chronic Diseases

The burden of chronic disease is substantial internationally and locally. According to World Health Organization (WHO) chronic diseases kill 41 million people annually. This accounts for 71% of all deaths worldwide. Each year, cardiovascular diseases account for most deaths globally (17.9 million people), followed by all types of cancer (9.0 million), respiratory diseases (3.9 million), and diabetes (1.6 million).[398] In 2015, 2.4 million out of 4 million deaths associated with elevated body mass index (BMI) occurred in people who were classified as obese.[399] Chronic diseases, the leading cause of death and disability in the United States, are among the most costly, but also, the most preventable.[400] Like the rest of the nation, Harris County has seen chronic diseases emerge as the leading cause of death, with seven of the top 10 causes attributable to chronic disease.[401] According to a report from the American Public Health Association, the five most costly and preventable chronic conditions cost this country nearly $347 billion, or 30% of total health spending.[402]



Introduction & Background

Chronic diseases affect every community and socioeconomic group in Harris County, but definitive health inequities and disparities are present in communities across the country as well as locally. For example, low-income, Black, and Hispanic populations are at higher risk for many of these conditions, including high blood pressure, diabetes, and obesity.[403] From 2013-2017, 79% of Black and 75.7% of Hispanic Harris County residents were overweight or obese, compared to 64.4% of White residents and 68.0% of all Texans.[404] The rate of heart disease in Black residents (7.9%) is more than double that of Hispanic residents (3.2%), and Blacks are more likely to have asthma (19.5%) compared to Whites (11.7%) and Hispanics (5.3%) in Harris County.[405]

As depicted in Figure 3.1, poor diet, physical inactivity, tobacco use, and chronic stress are modifiable risk factors shared across many chronic diseases. Figure 3.2 shows the percentage of adults who did not meet the Physical Activity Guidelines for Americans set by the Department of Health and Human Services. There are several neighborhoods in Harris County that have more than 47% of adults who did not meet this requirement. Though considered to be individual behaviors, these risk factors are heavily influenced by the environment and the previously referenced social determinants of health (SDOH).

The EHF recently conducted a study examining the role of community clinics in providing primary care in Harris County. Results of this study indicate Harris County has a robust supply of primary care access points, but specialty care remains one of the biggest challenges facing all community clinics in the county.[406] Additionally, access does not always translate to utilization, and access to specialty care during and after a disaster can be more difficult for individuals who are dependent on treatments such as dialysis and chemotherapy. Many organizations in Harris County make substantial efforts to prevent chronic disease. In addition to sites operated by HHD and the UT Health Science Center at Houston, HCPH operates 11 WIC centers throughout Harris County and oversees programs for healthy lifestyles, including nutrition and physical activity, tobacco prevention and cessation, behavioral health, and school health.

Because of our county's large size and the scope of the problem, partnerships are needed to address chronic disease. Some key partners in these efforts include:

Local school districts: Harris County school districts provide a setting for 1.2 million students to learn about health and healthy behaviors. **Houston Food Bank (HFB):** The HFB supplies fresh fruits and vegetables, along with other food items, to the HCPH Mobile Nutrition Unit. Additionally, they support health care partners wishing to implement food prescription programs. **American Heart Association (AHA)** - Houston: The AHA works with the Greater Houston Coalition for Social Determinants of Health, focusing on addressing food insecurity, and collaborates with local partners including HCPH on the Hypertension Taskforce. **Institute for Spirituality and Health (ISH):** ISH provides diabetes prevention training to faith-leaders as part of the Cities Changing Diabetes initiative.



Figure 3.1 Modifiable Risk Factors for Chronic Disease

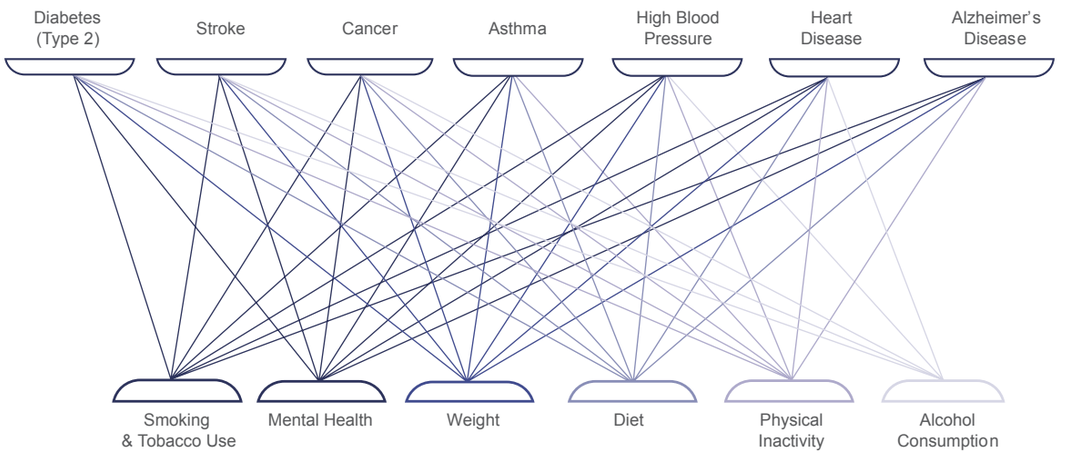


Figure 3.2 Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines by PUMA, Harris County, TX, 2018
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018

Figure 3.2 Adults with Low Physical Activity (%)

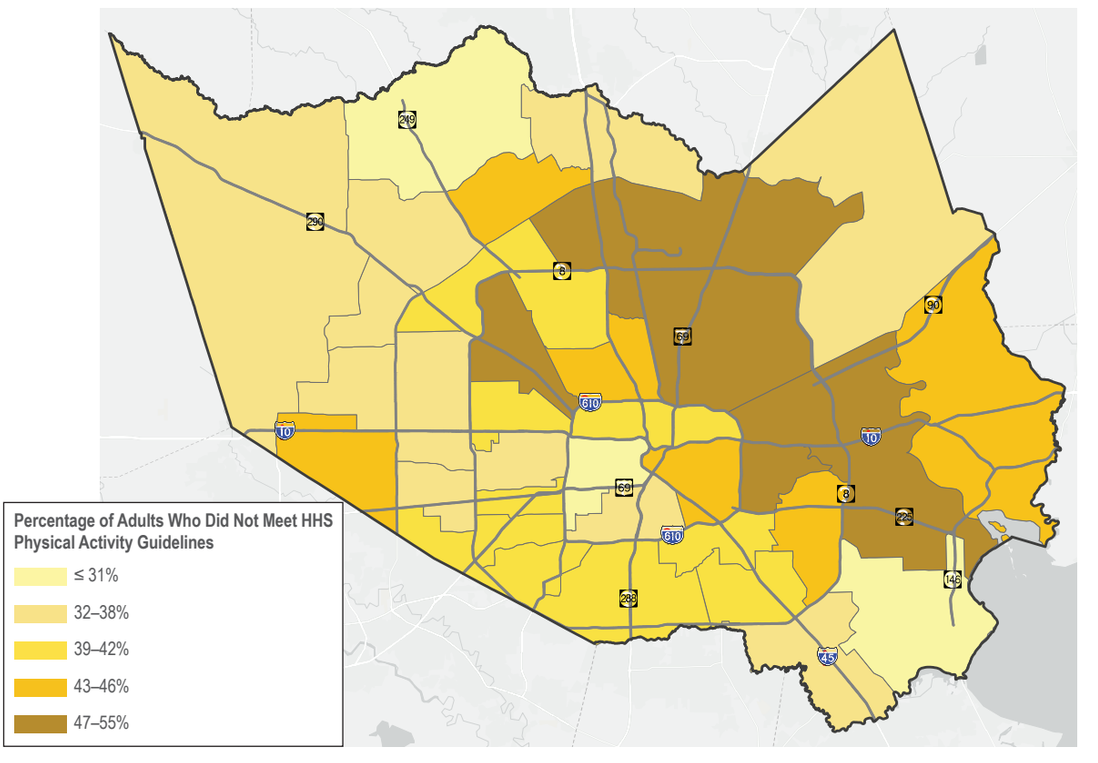


Figure 3.2 Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.



Cardiovascular Disease

Cardiovascular disease (CVD) is the leading cause of death locally, in Texas, nationally, and worldwide.[407,408,409,410,411,412] Over one-third of US adults have at least one type of CVD,[413] and heart disease and stroke are the first and fifth leading causes of death in the United States, respectively.[414] CVD can lead to disability, serious illness, and decreased quality of life.[415] Approximately one-third of adults in the United States are affected by high blood pressure, but only about 50% have achieved control of their condition with lifestyle changes and medication.[416] At the same time, approximately 90% of adults in the United States exceed recommendations for daily sodium intake,[417] which can raise blood pressure and increase the risk of CVD.[418]

In this country, CVD disproportionately affects specific age, sex, racial, and ethnic groups, as well as certain geographic areas and socioeconomic categories.[419,420] Substantial inequities exist across these groups for risk factors (overweight/obesity, physical inactivity, poor nutrition, smoking, high blood pressure, high blood cholesterol, diabetes, and periodontal disease),[421,422,423,424] as well as access to treatment, appropriateness and timeliness of treatment, treatment outcomes, and mortality.[425,426] Studies show Blacks are at higher risk of severe hypertension than Whites, and Chinese and Black are more likely to report having periodontal disease compared to Whites and Hispanics.[427,428] Women are 50% more likely than men to receive the wrong initial diagnosis following a heart attack,[429] and mental health conditions are among the highest alternative diagnoses for middle-aged women with coronary heart disease (CHD).[430] In addition, Blacks delay significantly longer than Whites (median 3.3 hours vs. 2.0 hours) when seeking treatment following the onset of heart attack symptoms.[431]

From 2013-2017, the percentage of Texas adults diagnosed with CVD increased slightly from 7.2% in 2013 to 7.8% in 2017, while the percentage decreased for Harris County adults from a high of 8.5% in 2014 to 5.7% in 2017.[432] Across racial and ethnic categories, non-Hispanic Blacks had the highest rate of CVD for this time period (11.3%), followed by Whites (8.8%), Asians (5.8%), and Hispanics (4.1%).[433] High blood pressure is the leading chronic disease diagnosis associated with hospitalization in Harris County.[434] In 2013, 17% of hospital visits in the county were associated with this diagnosis, increasing steadily to 19.7% in 2017.[435] For the same period, the percentage of hospital visits with a diagnosis of stroke more than doubled from 0.4% t o 1.1%.[436]

Pet Ownership and Heart Health

A growing body of evidence shows that owning a pet, particularly a dog, is associated with a decreased risk of cardiovascular disease. Studies suggest that dog owners have lower blood pressure, improved lipid profile, and diminished sympathetic response to stress than those who do not own a dog.[437] Further, a recent systematic review and meta-analysis found dog ownership is associated with an overall lower risk of death, which may be driven by a reduction in cardiovascular mortality.[438] Pets not only have a calming effect on humans and provide mental health benefits, but they also help promote physical activity which can reduce one's risk of developing cardiovascular disease.[439] Pet ownership aligns with the "One Health" approach that is key to understanding the complex interactions among people, animals, and the environment.

Diabetes

Diabetes is the seventh leading cause of death in the United States and the sixth leading cause of death in Harris County,[440] where diabetes prevalence is 11.0%.[441] Figure 3.3 shows the prevalence of diabetes in Harris County. Not surprisingly, the neighborhoods that have the highest percentage of adults with diabetes also tend to have the highest percentage of adults who do not meet the physical activity guidelines. According to the Behavioral Risk Factor Surveillance System (BRFSS) survey for 2011-2017, among individuals who had diabetes in Harris County, the highest rates were among individuals who were 45-64 years of age (16.5%), male (14.1%), and Hispanic (11.3%).[442]

Lifestyle changes related to nutrition and physical activity can prevent or delay the onset of type 2 diabetes in high-risk individuals.[443] Increasing concerns on the affordability of all medications and therapeutics – such as the cost of insulin and other diabetic supplies – is a significant issue for community residents and policy makers alike.

In collaboration with partners throughout the community, HCPH diabetes prevention efforts include community outreach to provide diabetes education and fresh fruits and vegetables through its Mobile Nutrition Unit. Further efforts are recommended to promote and expand the availability of the National Diabetes Prevention Program (DPP), especially for at-risk populations. As a component of the *Healthy Aging Program*, HCPH administers diabetes self-management education (DSME) in many communities across the county. DSME is an evidence-based program created by the Self-Management Resource Center that covers topics such as healthy eating, physical activity, appropriate use of medication, and techniques to deal with the symptoms of diabetes. The program is designed to be a supplement to proper and adequate health care.

Other prevention efforts in Harris County include the HHD's Diabetes Awareness and Wellness Network (DAWN) center located in Third Ward.[444] DAWN is a program accredited by the American Association of Diabetes Educators that provides evidence-based classes on topics such as fitness, nutrition, and self-management. The center also provides information and support for adults at risk for or diagnosed with prediabetes or type 2 diabetes.[445]

"Diabetes, high cholesterol and blood pressure are daily concerns that can plague an otherwise healthy lifestyle."

-Paul L., Harris County Resident

Figure 3.3 Adults with Diabetes (%)

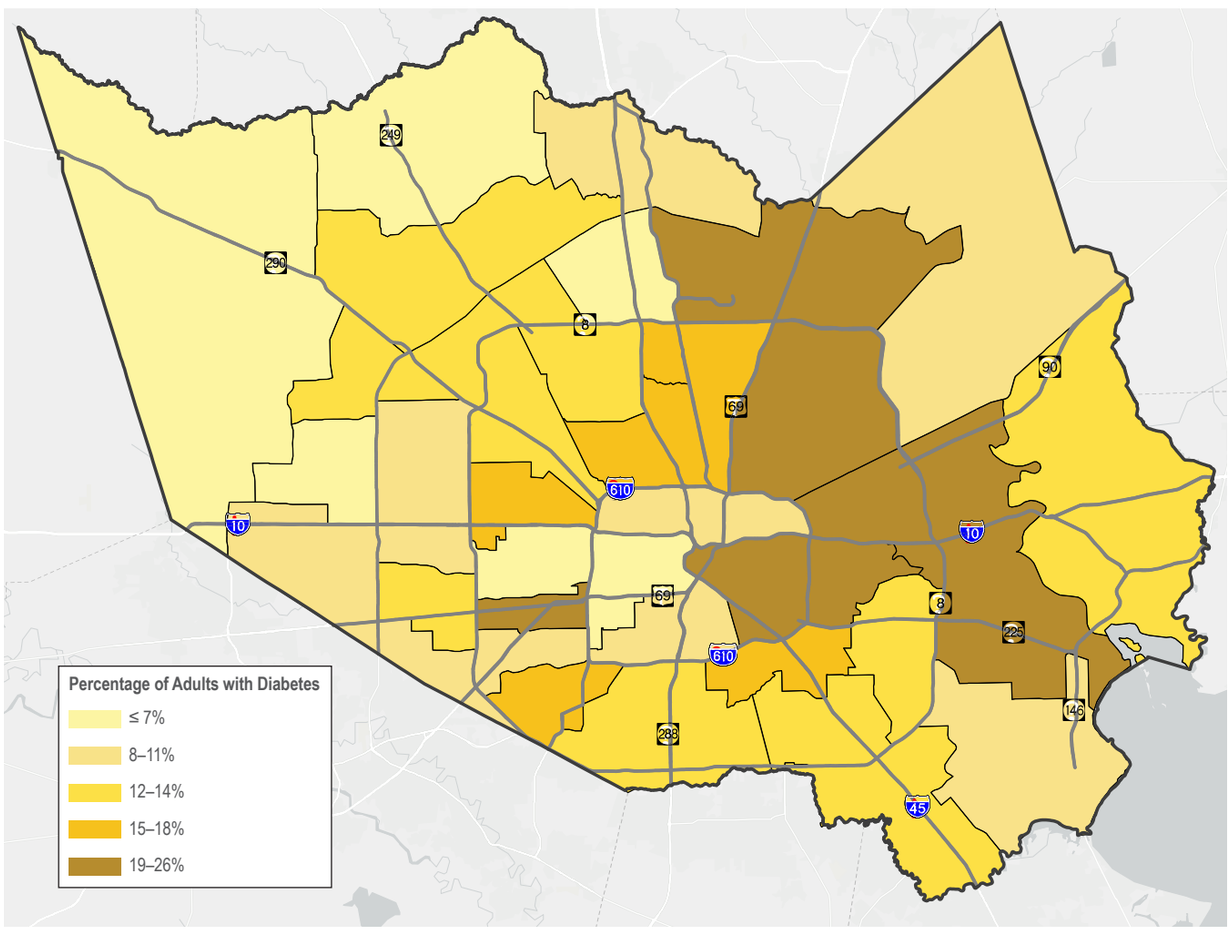


Figure 3.3 Percentage of Adults with Diabetes by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Cities Changing Diabetes

Cities Changing Diabetes was launched in 2014 by Novo Nordisk, University College London, and the Steno Diabetes Center with the belief that the growing prevalence of diabetes is not inevitable. Cities Changing Diabetes launched in Houston in November 2014 with a comprehensive analysis of the major gaps and vulnerabilities associated with diabetes. This analysis identified the need to improve community involvement and promote positive health behaviors. As a result, the partnership launched the Faith and Diabetes Initiative, which uses the influence of faith-based organizations to reach disproportionately affected individuals. These organizations deliver support and education to drive the prevention, detection and management of diabetes.

Obesity

Obesity is one of the nation's greatest public health challenges, affecting about 93.3 million or 39.8% of US adults in 2015-2016.[446] Its causes are complex (e.g., health behaviors, biological factors, the social environment, and other factors), as are its solutions.[447] It is linked to CVD risk factors such as elevated serum lipids and hypertension, type 2 diabetes, some cancers, osteoarthritis, and gallbladder disease.[448] Substantial disparities exist in minority and low-income communities.[449] According to BRFSS data, the prevalence of obesity in Harris County and Texas adults (32.8% vs. 33%, respectively) is similar.[450]

"I believe that preventive health care is the future of medicine and should be as strong as the traditional health system."

-Dr. John Graham, President and CEO, Institute for Spirituality and Health"

Figure 3.4 shows the percentage of adults in Harris County who are classified as obese based on their BMI at the neighborhood level. The neighborhoods, Baytown-Highlands, Galena Park-Jacinto City, and Greater Hobby-Edgebrook had the highest percentage of adults who were considered obese, with over 40% of the adult population having a BMI over 30. Over 50% of Galena Park-Jacinto City adult residents were classified as obese.[451]

In Harris County, one-third of youths (aged 12-17) are overweight or obese.[452] State law requires school districts to assess the physical fitness of students enrolled in grade three or higher annually using the FitnessGram assessment. Data for reporting school districts from the 2013-2014 school year's assessment show that 32% of students in Harris County are at high risk of obesity based on their current BMI.[453] Figure 3.5 and Table 3.1 highlight the percentage of students who are considered at high risk for obesity, by independent school districts within Harris County.

HCPH's obesity prevention work includes such programs and services as WIC, Healthy Living Matters (HLM), and an Obesity Reduction/Outreach Unit. In addition to its WIC centers, HCPH will soon begin operating a WIC Mobile Unit. Created in 2011 with funding from the Houston Endowment, **HLM is a nationally recognized multi-sector collaborative made up of over 80 organizations and 110 individuals aimed at curbing childhood obesity** through policy change, environmental change, and upstream intervention.

HLM members and partners engaged in a two-year planning initiative led by HCPH to: assess food access and the built environment in Harris County, provide educational opportunities, scan and monitor federal, state, and local policy trends, identify local issues, and prioritize policies related to childhood obesity. Since then, HLM has continued to mobilize policy action to reduce and prevent childhood obesity in Harris County in collaboration with various county agencies. Finally, HCPH collaborates with over 15 school districts and 12 community centers to provide an evidence-based obesity reduction curriculum to youth. These programs and other broad-based initiatives follow frameworks for upstream interventions that begin to affect the root causes of chronic diseases.

HCPH collaborates with various municipalities for data sharing, including with partners like the City of Pasadena's Health Department. The City of Pasadena provided data on restaurant inspections to support the *Healthy Dining Matters* initiative. This program worked with local restaurants and helped them improve the nutritional content of their dishes, offering guests some healthier menu options. Before recruiting restaurants, HCPH received food inspection data from the City of Pasadena to determine if the restaurants were eligible for the program.

Go Healthy Houston Initiative

Go Healthy Houston was launched September of 2012 and is designed to reduce obesity and increase healthy eating and exercise. The Go Healthy Houston initiative promotes programs, policies and projects designed to reduce food deserts, promote the availability of locally-grown foods, encourage the development of sustainable food systems, and promote physical activity opportunities.

Figure 3.4 Adults Who Are Classified as Obese (%)

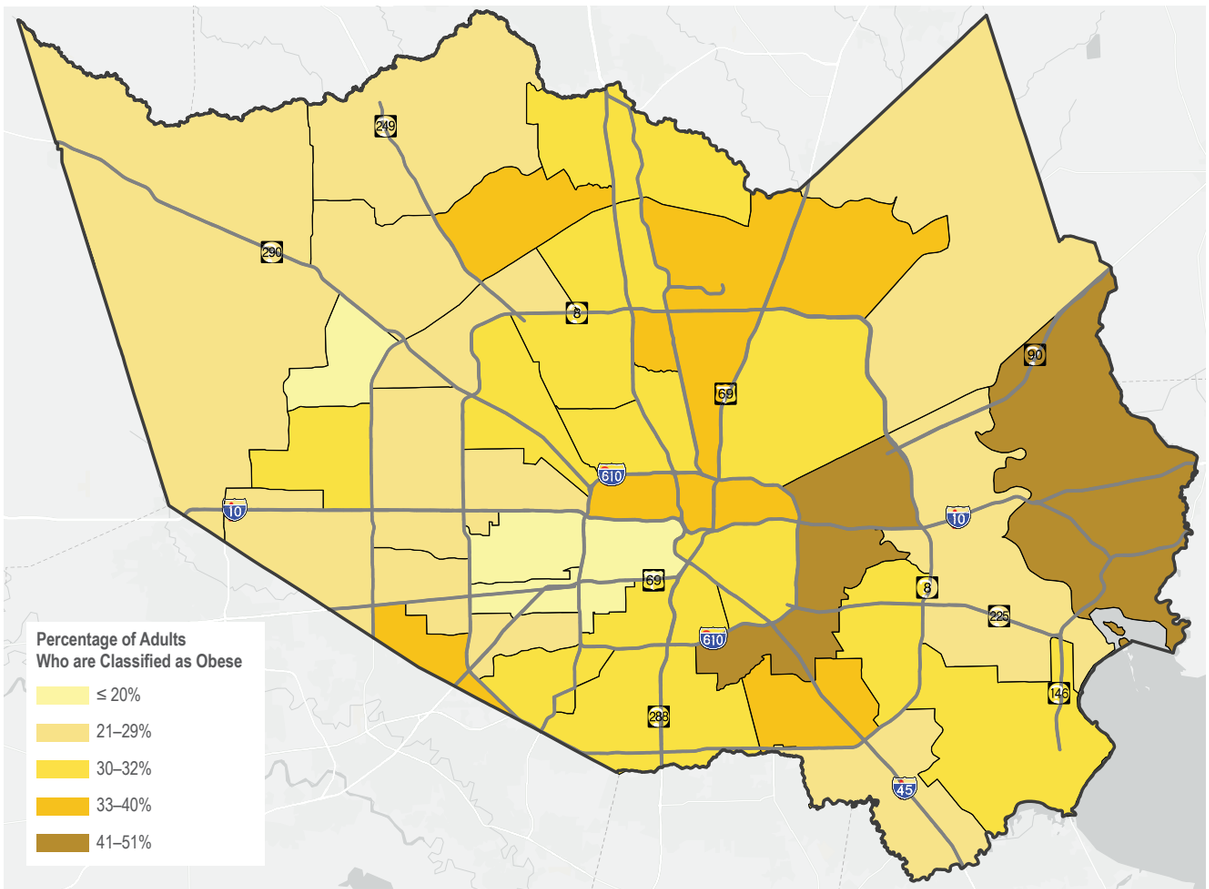


Figure 3.4 Percentage of Adults Who Are Considered Obese by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Figure 3.5 Students at High Risk of Obesity (%)

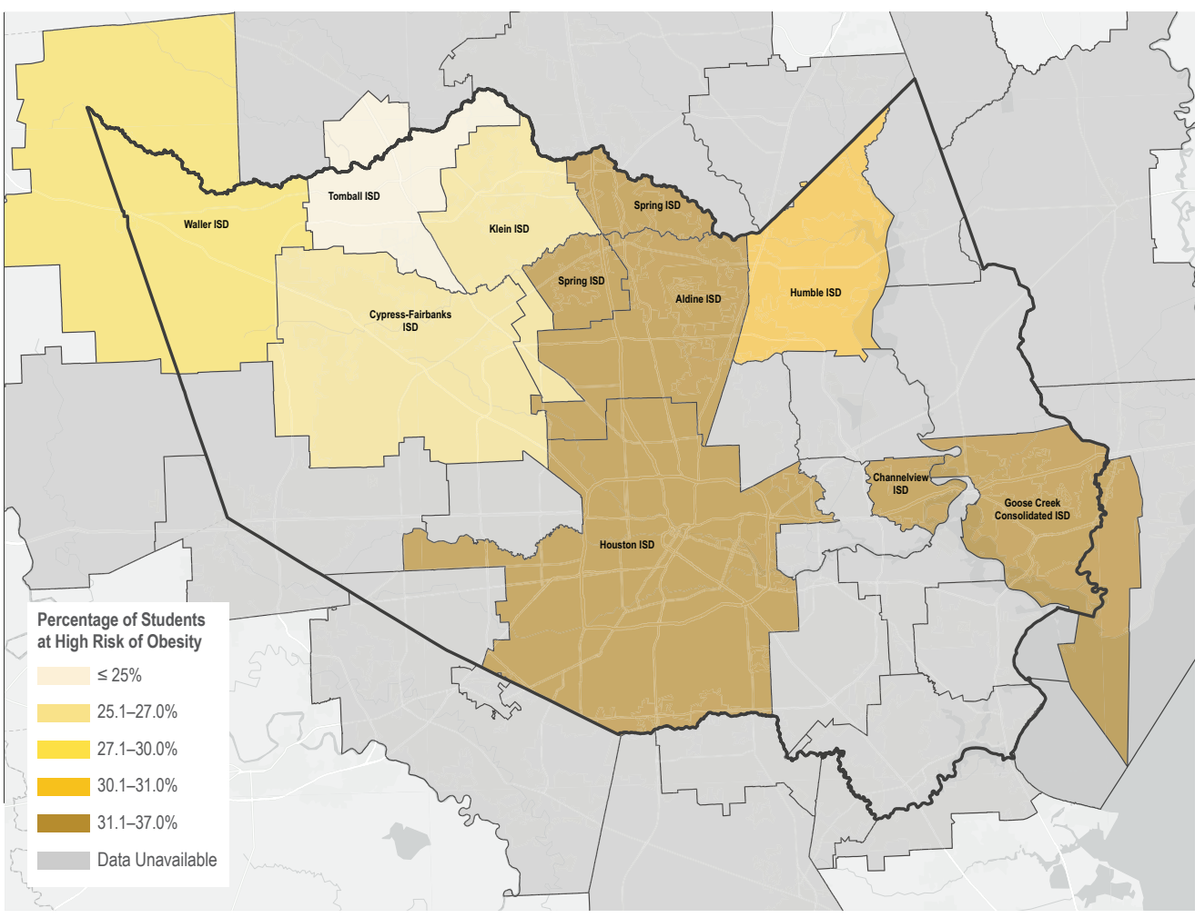


Table 3.1 Students at High Risk of Obesity (%)

Reporting Harris County Independent School District (ISD)	Percent of Students at High Risk of Obesity
Aldine ISD	37%
Channelview ISD	35%
Cypress-Fairbanks ISD	27%
Goose Creek Consolidated ISD	35%
Houston ISD	37%
Humble ISD	31%
Klein ISD	27%
Spring ISD	37%
Tomball ISD	25%
Waller ISD	30%
Harris County Average	**32%**

Table 3.1 Percentage of Students at High Risk of Obesity by Independent School District, Harris County, TX, 2013-2014.
Source: Texas Education Agency, 2013-2014.

Cancer

In 2016, cancer was the second leading cause of death in the US after heart disease.[454] Excluding nonmelanoma skin cancers, breast, lung, prostate, and colorectal cancers are the most commonly diagnosed cancers in the US.[455] Although cancer mortality rates have recently declined in the US, nevertheless 1,762,450 new cancer cases and 606,880 cancer deaths are expected to occur in 2019.[456] Prostate, lung, and colorectal cancers make up 42% of cancer cases among men, while breast, lung, and colorectal cancers account for 50% of cancer cases among women.[457]

Breast cancer disproportionately affects women and makes up one-third of the total cancer cases among women,[458] but mammograms increase early detection and lower mortality risk.[459] In 2016, 69% of Harris County women aged 40 years or older reported receiving a mammogram within the last two years;[460] the Texas Cancer Plan 2023 goal for mammography among women aged 50-74 years is 81%.[461] Hospitalizations related to breast cancer increased from 0.13% of total cancer hospitalizations in 2013 to 0.22% in 2017.[462]

According to the American Cancer Society, one-quarter of all cancer deaths are expected to result from lung cancer in 2019.[463] Lung cancer deaths have declined, however, by 48% from 1990 to 2016 among men and by 23% from 2002 to 2016 among women.[464] These declines can be attributed to steady reductions in smoking.[465]

Many risk factors for cancer are modifiable through lifestyle changes. The American Cancer Society and WHO estimate that 30-50% of all cancer cases are preventable.[466,467] Data suggests approximately 19% of cancer cases in the US are caused by smoking and 18% are attributable to a combination of poor diet, excess body weight, and physical inactivity.[468]

While human papilloma virus (HPV) associated cancers in the United States account for only 3% of all cancer cases in women and 2% in men, they are among the most preventable because of screening and vaccination.[469,470] The burden of these conditions can be reduced through vaccination targeting adolescent boys and girls ages 9-15, which substantially decreases the risk of six HPV-related cancers.[471] In 2017, 74% of Houston females aged 13-17 years received the HPV vaccine, and the rate was similar (72%) for males in the same age group.[472]

Projections suggest Texas will have an estimated 124,890 new cancer cases and 41,300 cancer deaths in 2019.[473] Certain areas of Harris County are disproportionately burdened with higher cancer rates than other areas. Deer Park-Channelview has the highest percentage of residents who have been diagnosed with cancer at 13% followed by Pasadena (South)-LaPorte and Eldridge-Cinco Ranch both with rates of 10%. Much of the southern part of Harris County has higher cancer diagnosis rates compared to other parts of the county.[474] Over the past 25 years, the death rate from cancer in the Unnited States has declined steadily, falling approximately 27% from its peak in 1991.[475] This translates to roughly 2.6 million deaths avoided between 1991 and 2016, primarily attributable to steady reductions in smoking along with advances in early detection, treatment, and prevention.[476] Despite this decline, a substantial disparity exists in cancer prevention based on race and ethnicity, region of residence, and socioeconomic status.[477]

Research suggests further reductions in cancer mortality are possible with greater attention to broader and more equitable interventions.[478] As the cancer death rate declines, cancer survivorship will increase to 20.3 million people by 2026.[479] This highlights the importance of survivors' overall well-being and investments in public health interventions such as disease self-management, promotion of healthy lifestyles, and educational programming.[480]

Currently, HCPH engages in cancer prevention efforts including several tobacco cessation programs throughout the county, and in collaboration with MD Anderson Cancer Center and other partners, educational and outreach efforts focused on sun safety in communities like Baytown. In addition, HCPH works with the Cancer Alliance of Texas to stay informed of advancements related to cancer and statewide initiatives to prevent cancer at the state level as well as here locally in Harris County. During the 86th Texas legislative session, Senate Bill 21 was passed increasing the legal age from 18 to 21 for the sale, distribution, possession, purchase, consumption or receipt of cigarettes, e-cigarettes or tobacco products.[481]

"Improving the bridge between public health services and the places where delivery of health services is done can greatly improve the health of the community."

-Dr. Uzma Iqbal, Board Member, HCA Gulf Coast

Sun Safety Information through LA County 211

211 LA County is the central source for providing information and referrals for all health and human services in LA County. Their 2-1-1 phone line is staffed by trained Community Resource Advisors prepared to offer help with any situation, any time, including recommendations on what sunscreen to use and how to use it correctly.[482]

Alzheimer's Disease and Dementia

Alzheimer's disease is the most common form of dementia, making up 60-70% of cases.[483] Dementia is a major cause of disability and dependency among older people, resulting in serious challenges for patients, caregivers, and families.[484] As the population ages, the burden of age-related disease such as dementia is predicted to grow.[485] Globally, nearly 10 million new cases of dementia are diagnosed annually, and projections suggest that 82 million people will be living with the condition in 2030, and 152 million by 2050.[486]

Estimates show adult cases of dementia in the United States will increase from five million in 2014 to 14 million by 2060.[487] In 2018, there were more than 380,000 Texans living with Alzheimer's disease, and over 1,380,000 family and friends who were providing care.[488] In Harris County, the Medicare population with Alzheimer's disease or dementia increased from 12% in 2009 to 13% in 2017.[489]

Age is the strongest known risk factor for dementia, but it is not an inevitable part of aging and does not exclusively affect older people. In fact, 5% of cases are in those under the age of 65.[490] Additional risk factors include depression, low educational attainment, social isolation, and cognitive inactivity.[491] Emerging evidence suggests Alzheimer's may also be linked with periodontal disease.[492,493] Those with a family history of dementia are more likely to develop the condition, and traumatic brain injuries may also increase risk.[494] Older Blacks are twice as likely, and Hispanics 1.5 times as likely to have dementia compared to Whites.[495]

While no treatment or cure exists for Alzheimer's disease or dementia, opportunities exist to support individuals with these conditions and prevent dementia progression.[496] These include early diagnosis, optimizing physical health, cognition, activity, and well-being, and identifying and treating accompanying physical illness.[497] Regular exercise, refraining from smoking and harmful use of alcohol, controlling body weight, eating a healthy diet, and maintaining healthy blood pressure, cholesterol, and blood sugar have been shown to reduce the risk of dementia.[498]

Other preventive measures include reducing head injury risk by wearing seat belts while driving, using helmets during sports, and "fall-proofing" the home.[499] Preventing Alzheimer's disease could eliminate $20.2 trillion in unpaid care and save the Texas Medicaid program $2.8 billion in medical costs per year.[500] System-wide, collaborative efforts to implement healthy lifestyle strategies for the aging community are essential to lowering the burden of Alzheimer's disease and dementia.

HCPH offers an array of healthy aging programs that address mental and physical health, including self-management and prevention classes. Tai chi for memory is designed specifically to promote memory maintenance by supporting emotional balance, social interactions, and general health.[501] In addition, HCPH partners with the local Alzheimer's Association chapter to provide a number of services to the community such as supporting the Senior Olympics in Precinct 2, creating newsletters with information on healthy aging and dementia, and providing presentations in senior community centers across the county.

The Houston and Southeast Texas Chapter of the Alzheimer's Association also implements other community programs to promote the importance of brain health and support Alzheimer's research. The annual Walk to End Alzheimer's is an effort to raise funds and awareness for research related to the disease. Multiple walks are held around the county, state, and country every year.

Tri-County Health Department's A Matter of Balance

The Tri-County Health Department (TCHD), servicing Adams, Arapahoe, and Douglas Counties in Colorado, offers various falls prevention resources for older adults. TCHD is the regional coordinating agency for *A Matter of Balance*, a program designed to reduce the fear of falling and increase activity among older adults. TCHD engaged with community organizations to offer this class at no cost.502

Asthma and Chronic Obstructive Pulmonary Disease

Asthma is one of the most common chronic lung conditions and affects 8% of the US population which is greater than the global burden of 4%.[503] In Texas and Harris County, 7% and 5% of adults have asthma, respectively.[504,505] In Harris County, for children under 18 years, the prevalence is 10%.[506] Asthma is more common in males than females and the prevalence is greatest in non-Hispanic Blacks compared to non-Hispanic Whites and Hispanics.[507] Risk factors for asthma include but are not limited to family history; allergies or allergic conditions; exposure to smog and other environmental triggers like chemicals, vapors, dust; and smoking or exposure to secondhand smoke.

Chronic obstructive pulmonary disease (COPD) is the third most common cause of death in the United States and has gained substantial attention because of its association with high hospital admission and readmission rates.[508] In Harris County, 3% of hospitalizations in 2017 were associated with COPD (not including unspecified bronchitis).[509] Risk factors for chronic respiratory diseases include tobacco smoke, air pollution, occupational chemicals and dust, and frequent respiratory infections during childhood.[510,511] These diseases are not curable, but they can be treated, and triggers can be mitigated.[512] About half of COPD cases are attributable to lifelong cigarette smoking,[513] meaning they are largely preventable through decreases in smoking initiation and through tobacco cessation.

A rapidly growing concern related to lung health is the use of electronic cigarettes (e-cigs), or vaping, which was once thought to be a safer alternative to smoking cigarettes. Recently, vaping related hospitalizations resulting from severe pulmonary lung disease have increased. As of October 8, 2019, 1,299 lung injury cases associated with the use of e-cigarette, or vaping, products have been reported to CDC from 49 states, the District of Columbia, and one US territory. Twenty-six deaths have been confirmed in 21 states.[514] This emerging issue is a growing concern for its short-term and long-term effects on lung health.

While many efforts are underway to address the burden of respiratory diseases, whether acute or chronic, inadequate resources are being spent in this area on prevention. Instead, affected individuals find themselves requiring urgent or emergency care at a much higher cost within the health care system.[515] The Houston Ship Channel is one of the busiest seaports in the United States. In addition to the ship channel, Harris County is home to the largest petrochemical hub in the United States.[516]

Harris County is growing at unprecedented rates which brings more car traffic and pollution. All these factors combined contribute to the poor air quality in the community. In fact, in the 2019 State of the Air Report, Houston ranked number nine on the list of most polluted cities.[517] As mentioned previously, poor indoor and outdoor air quality is a risk factor for asthma and other lung diseases, therefore prevention is critical. Current prevention efforts for asthma include "healthy home" interventions and self-management programs, which demonstrate strong evidence of effectiveness.[518]

HCPH offers Open Airways for Schools (OAS) and Kickin' Asthma, which are American Lung Association education programs that improves self-management skills among children and teens. HCPH has also partnered with MD Anderson Cancer Center to train staff on the Certified Tobacco Treatment Program for tobacco cessation. HCPH is a member of the Houston Asthma Coalition, which is a convening of multi-sector partners that meet to strategically plan efforts to prevent asthma and the associated triggers in various settings throughout the county.

The *Tobacco Cessation* program at HCPH facilitates education and cessation services in a four-week session format and receives support from the Texas Quitline. The program has updated its curriculum with information about alternatives to tobacco use, including the use of e-cigarettes. HCPH continues to partner with local school districts to provide education for a larger proportion of school-aged children and young adults about e-cigarette use to help prevent the risk of acute lung injury. Vaping is the latest in a series of public health concerns where it makes sense to invest in prevention up-front (or upstream) rather than waiting for the costlier downstream consequences that must be addressed in the health care system.

The mission of Air Alliance Houston is to improve the air in Houston/Harris County through research, education, and advocacy.[519] The agency hosts community forums and workshops to educate Harris County residents on air quality, partners with advocacy groups around the county, and publishes articles on the latest research surrounding air quality and health in the region.

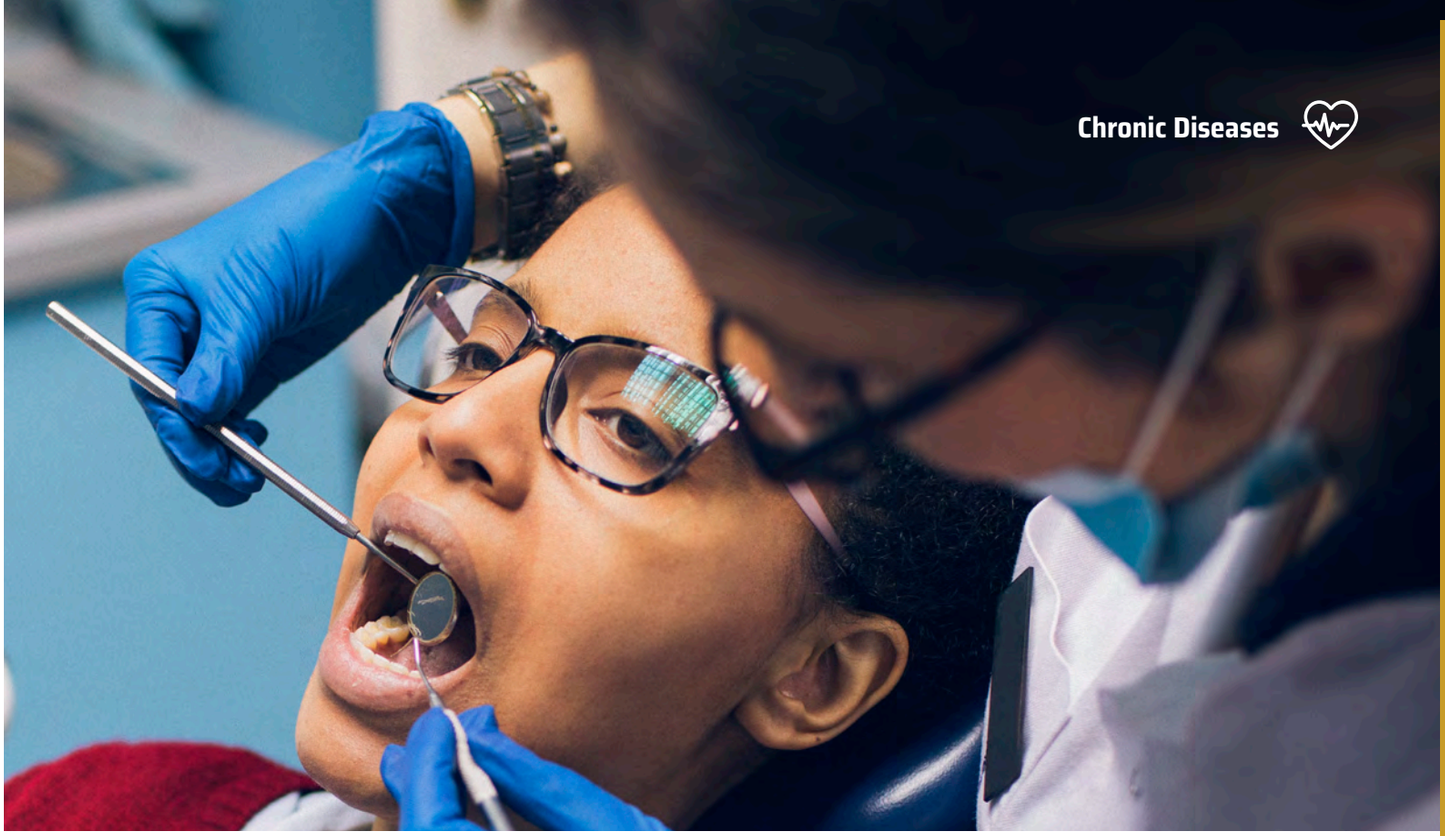
New York City Asthma Partnership

The New York City Asthma Partnership (NYCAP) is a coalition of over 300 individuals and organizations who share an interest in reversing the asthma epidemic in New York City. Their mission is to develop and advance citywide collaboration for asthma prevention and control. Committees include: Community education, early childhood, schools, environment, data and research, and health care delivery.[520]

Dental Health

In the field of oral health, the mouth is considered a "window into the body." Often the first signs of chronic and infectious diseases can be seen by examining oral manifestations of those conditions. In fact, there is an increasing body of evidence that festering dental diseases can cause ongoing inflammation leading to worsening of such common conditions such as heart disease, psoriasis, etc.

Dentists and dental health professionals often work closely with physicians and other health care team members including nurses to request screenings for chronic disease conditions that may go undiagnosed. Furthermore, patients who are diagnosed with certain chronic diseases may need to see their dentist more frequently to ensure the bacterial burden of oral disease is kept at a minimum to help them manage their chronic conditions.



Oral cancer screenings are a standard of care in oral health settings. They provide an opportunity for an oral health care provider to influence behavior modifications by educating patients about tobacco use, alcohol use, the importance of the HPV vaccine and the risk of death from oral and oropharyngeal cancers is critical to saving lives. Oral and pharyngeal cancers are primarily diagnosed in older adults with a median age at diagnosis of 62 years.[521]

The ability to maintain a good quality of life as an older adult is almost impossible without maintaining oral health – older adults often suffer from common oral conditions related to chronic conditions they may have – dry mouth associated with medication side effects can be a vicious cycle for older adults which may lead to rampant decay, loss of teeth, inability to eat well, weight loss and can also have mental health impacts as a result.

Research also shows that prevention for dental health pays off. In many communities, every $1 spent on water fluoridation saves $38 in dental costs. Researchers estimate that in 2003 Colorado saved nearly $149 million in dental treatment costs because of fluoride in the public water supplies. A recent Texas study revealed that fluoridation saved taxpayers $24 per child, per year in state Medicaid costs.[522] Poor oral health has costs to the community. Americans made an estimated 830,590 visits to hospital emergency rooms in 2009 for dental conditions that were preventable.[523] Tooth decay is the most common chronic disease of early childhood. In fact, it's a condition that is 2-3 times more common than asthma or obesity.[524]

While the specifics of dental care infrastructure and opportunity of improvement are beyond the scope of this study, the authors recognize its vital importance to the health of a community.

"We had a lot of fun at the Mobile Health Village. The kids got their teeth checked, and we found a lot about all the services the county provides. It was very informative. I think it's great... it brings the community out, and it shows that the county cares about helping the community how [sic] to be healthy."

-Aaron M., Harris County Resident

Conclusion

Chronic diseases can only be effectively prevented, managed, and treated when we focus on the transformational recommendations. Most specific to chronic disease is the recommendation to align strategies that improve health with the intention of increasing coordination, collaboration, and communication among partners. As stated previously, HCPH is well positioned to serve as the backbone agency to convene partners in public health and health care sectors and has done this on many occasions utilizing the collective impact model. Examples include the Greater Houston Coalition on Social Determinants of Health, Healthy Living Matters, and the Harris County BUILD Health Challenge. In efforts where HCPH is not the convener, it serves on various coalitions that address the prevention of chronic disease and/or its social determinants of health, such as Cities Changing Diabetes, Be Well Baytown, and Pasadena Vibrant Communities initiatives. Whether convening or participating, HCPH is dedicated to working together with others to eradicate chronic disease in Harris County.



CHRONIC DISEASES

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 11 Recommendations

- Promote multi-component chronic disease interventions delivered throughout Harris County that combine educational, environmental, and behavioral activities.
- Support initiatives that improve indoor air quality for all county residents, with a particular emphasis on those who are disproportionately impacted.
- Invest in public health education campaigns to raise awareness of chronic disease prevention and management for all county residents, with a particular emphasis on those who are disproportionately impacted.
- Advocate for additional state and federal funding and policies that increase the capability and capacity of tobacco cessation programs in Harris County, including e-cigarettes/vaping.
- Encourage Harris County to support policies and initiatives that develop and promote use of healthy, affordable, and safe options for food, including addressing food deserts.
- Support initiatives to provide widespread access to affordable vaccines to prevent chronic diseases in Harris County, with a particular emphasis on those who are disproportionately impacted.
- Build Harris County capacity to acquire, analyze, and leverage local chronic disease health data.
- Encourage multisector collaborations and convenings to address chronic disease prevention and management challenges for all county residents, with a particular emphasis on those who are disproportionately impacted.





"Understanding the environmental context in which we live, work and play is essential to ensuring population-level safety. County, city and state health departments play a key role in translating this understanding to prevention of injury and violence in our communities."

Dr. Joyce Presley,
Associate Professor, Columbia University

12

Injuries

An injury is defined as any harm or damage done or sustained to the body. They can be unintentional (e.g. accidental traffic collisions, drowning, poisoning, and falls) or intentional (e.g. violence, abuse, and self-inflicted harm). Injuries affect people of all ages, genders, races, or economic status. Those who survive injuries may endure temporary or permanent disability and reduced quality of life. Overall, the repercussions of injuries include physical harm, emotional harm, and financial harm in the form of medical costs and loss of productivity or economic opportunity.

Each year over five million people around the world die from injuries, accounting for 9% for all deaths globally. Several millions more are harmed from injury each year.[525] In the United States, 214,000 people die each year from injuries.[526] Across the nation, injuries caused more than 2.8 million hospitalizations and 27.6 million emergency department visits for treatment in 2015.[527] Injuries cost $671 billion in medical costs and work loss across the nation in 2013. Nearly 20% of that total cost was from unintentional injuries.[528] Falls and transportation-related injuries are the top injuries that contribute to the cost spent in emergency departments in the United States.[529] Strong scientific evidence has shown several policies and laws to be effective in preventing different types of injuries. Injury trends in Texas and Harris County are consistent with national trends.

This chapter will discuss both intentional and unintentional injury, the state of the public health and health care infrastructure for injury and violence prevention, and provide recommendations that the health care and public health systems should consider.

Overall Burden of Injury and Violence

Intentional injuries are the result of actions performed to hurt oneself or others, including attempted suicide, homicide, and domestic violence. Violence is heavily associated with intentional injury. Unintentional injuries are unplanned incidents, such as falls or motor vehicle crashes. Classifying between types of injuries is useful to understand risk factors and to develop effective prevention strategies. Injury and violence can be influenced by individual behavior, the built environment, the social environment, and access to care. And they have lasting impacts on health. Prevention is critical for reducing the prevalence and severity of both intentional and unintentional injury. Prevention reduces premature death, number of potential life years lost, mental health issues associated with the trauma of injury and violence, and lost productivity due to disability.[530]

Injuries are a leading cause of death in the United States. In Harris County, injury has been the second leading cause of death each year from 2015 to 2017. In 2015, 1,491 deaths were caused by accidents, as shown in Table 3.2 that lists the top 15 causes of death in Harris County. Of those fatal accidents, 465 were caused from motor vehicle accidents for an age-adjusted death rate of 10.3 per 100,000 population. The age-adjusted death rate for assault was 9.5 per 100,000 population, higher than the 5.6 death rate for the state of Texas. Suicide accounted for 461 of the 25,342 total recorded deaths in Harris County in 2015.[531,532]

Thousands of people endure non-fatal injuries, resulting in emergency department visits and hospitalizations. Nationally, the average medical cost per injury was nearly $11,000 in 2014.[533] In Harris County, falls and motor vehicle accidents account for the majority of hospitalizations caused by injury, as shown in Figure 3.6. In 2014 in Harris County, the total medical costs due to injury was $150 million. However, these costs don't cover additional expenses due to continued mental and physical problems resulting from the initial injury.

Apart from prevention, access to health services is essential for injury and violence reduction. Nonfatal injuries may worsen or become fatal if a victim is unable to receive adequate prehospital, acute, or rehabilitation care, whether due to transportation barriers, lack of health insurance or financial strain, or lack of knowledge about available resources. HCPH has created a "Strategies and Tactics to Oversee the Prevention of Violence Taskforce" or STOP Violence Taskforce to help address violence in the community.

Table 3.2 Top 15 Causes of Death

Causes of Death	Total Number of Deaths
Diseases of the Heart	5,669
Malignant Neoplasms	5,414
All Other Diseases	3,620
Accidents	1,491
Cerebrovascular Diseases	1,332
Chronic Lower Respiratory Diseases	947
Alzheimer's Disease	876
Septicemia	870
Diabetes Mellitus	743
Nephritis, Nephrotic Syndrome, and Nephrosis	655
Suicide	461
Chronic Liver Disease and Cirrhosis	451
Homicide	441
Influenza and Pneumonia	439
Essential Hypertension and Hypertensive Renal Disease	318

Table 3.2 Top 15 Causes of Death, Harris County, TX, 2015.
Source: Center for Health Statistics, Texas Department of State Health Services, 2015.

Figure 3.6 Hospitalizations by Injury

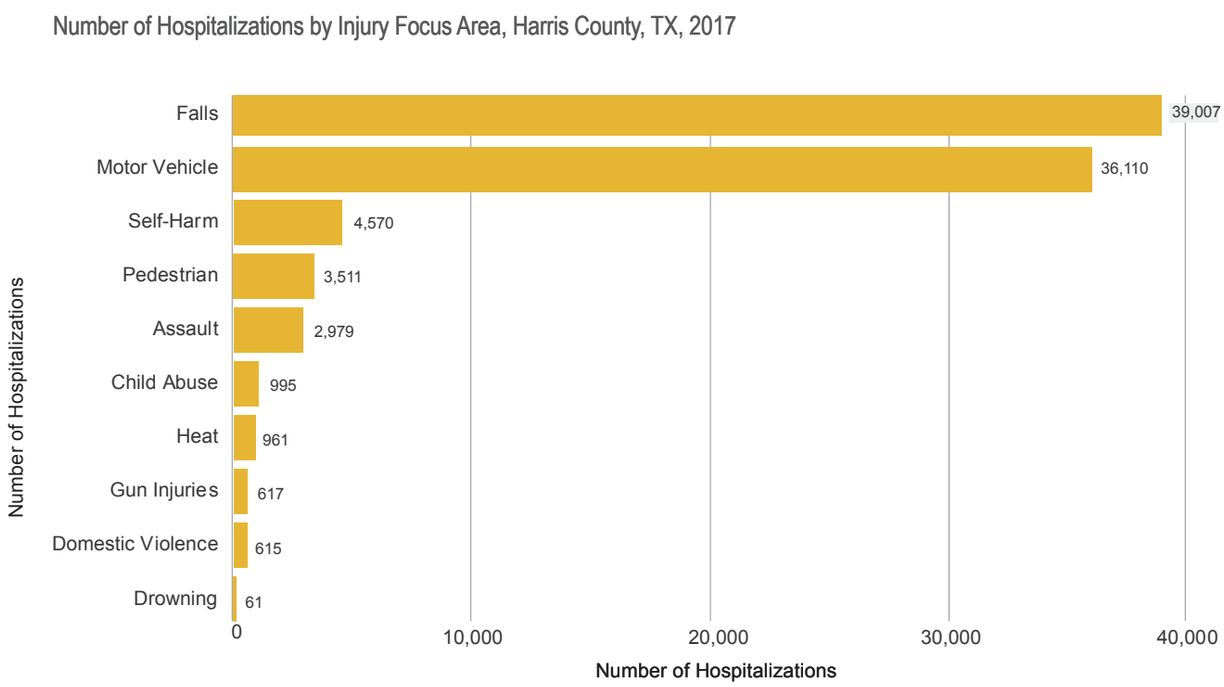


Figure 3.6 Number of Hospitalizations by Injury Focus Area, Harris County, TX, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Gun Violence

Gun violence is an incident where harm is caused using a firearm, or gun. This includes being shot at, injured, or killed by a gun. Homicide is one of the top leading causes of death among adults 18 to 64 years of age in Harris County. There were 611 deaths from gun injury, whether intentional or unintentional, in 2017. The age-adjusted death rate from guns in 2017 was 13.2 per 100,000, slightly lower than the rate of 13.7 in 2016.[534] From 1999 to 2017, the age-adjusted death rate for gun-related suicide in Harris County has been higher than comparable large metropolitan areas such as Dallas County and Los Angeles County respectively. Over the same 18-year time period, the age-adjusted death rate for gun-related homicide has been similar to the average rate for large central metropolitan counties in the United States (Figure 3.7). Guns are a frequent method of suicide and in Harris County, 280 lives were lost due to suicide gun injury in 2017.[535]

Gun violence also indirectly affects the health and well-being of those witness to the violence or living within those communities. Living near or around gun and community violence has not only physical but also psychological effects. People may suffer from mental health issues like anxiety, post-traumatic stress disorder (PTSD), and suicidal thoughts from witnessing or experiencing gun violence. The consequences of gun violence harm individuals, families, and communities. It is a public health as well as a health care issue, even though it is often thought of as a criminal justice or political issue. All of these areas must work together in order to ensure the health and well-being of Harris County residents.

Several risk factors are associated with gun violence. Exposure to violence, or community violence, is an individual factor that can influence individuals to engage in violence themselves. Family risk factors include low parental involvement or authoritarian parenting approaches. Peer and social factors like involvement in gangs and poor academic performance affect young people. Community factors such as diminished economic opportunities and low levels of community participation can lead to gun violence.[536] Access to guns and insufficient gun safety also influence the likelihood of injury or fatality from firearms.[537]

Mass shootings are a concern at the national and local level. A mass shooting is a single incident where multiple individuals are killed from guns.[538] According to the Gun Violence Archive, there has been over 250 mass shootings so far in 2019. These shooting have caused an increase in the US media coverage and public outcry which has influenced public perception of the frequency of mass shootings and gun violence in general.[539] It has helped drive conversations about gun control law, mental health services, and active shooter drills in schools.

Figure 3.7 Gun-Related Deaths

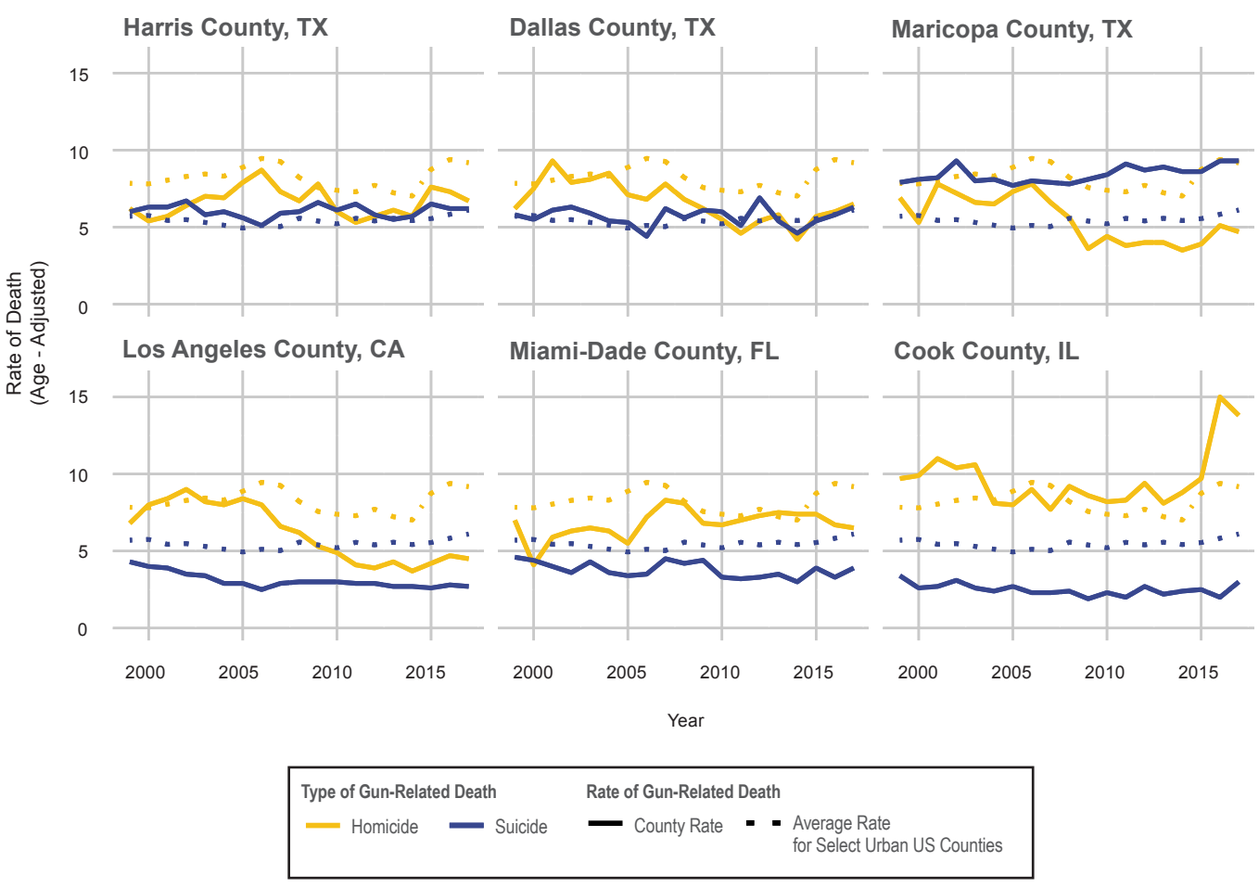


Figure 3.7 Age-Adjusted Gun-Related Deaths per 100,000 People by Type and Location, Select Urban US Counties, 1999-2017.
Source: CDC WONDER, Centers for Disease Control and Prevention, 1999-2017.



Gun Violence: Public Health and Health Care Infrastructure

Many community partners manage programs or offer education for gun violence. For example, the Harris County Department of Education operates the Safe and Secure Schools Program to support school districts in enhancing safety and security. In addition to general evacuation plans, the program provides active shooter and "intruderology" (special training to protect students from an intruder) training for staff and administrators of schools.[540] After the Sutherland Springs shooting in 2017, the McGovern Center for Humanities and Ethics from the UTHealth McGovern Medical developed a class, *Gun Violence and Physicians*, to educate health care professionals on the state of the problem and how to respond to it in practice.[541] McGovern Medical School operates the UT Physicians clinical practice with hospital affiliations, including Harris Health and the Harris Center.

Self-Inflicted Injury

Suicide is an intentional self-inflicted injury, leading to death, caused by gunshot, sharp object, hanging, suffocation or drug overdose.[542] However, there are some self-inflicted injuries that are not considered suicide attempts, but are instead, actions taken to hurt oneself intentionally, usually through cutting, burning, picking wounds, or alcohol or substance abuse. Self-inflicted injuries are often coping mechanisms for managing emotional pain, anger, frustration, and trauma.[543]

Some self-inflicted injuries may be unintentional, a consequence of engaging in certain activities and behaviors. Self-medicating with alcohol, prescription drugs, and smoking substances like tobacco, marijuana, and the mixtures contained in electronic cigarettes can lead to unintentional injuries. Teenagers and young adults are more likely to engage in many of these behaviors of self-inflicted injury.[544] Alcohol and substance abuse can lead to acute lung injury, which can lead to long-term morbidity and mortality due to decreased lung function.

According to the 2016 County Health Rankings, there were 1,200 drug overdose deaths in Harris County between 2012 and 2014, a mortality rate of 9 per 100,000 population.[545] This rate does not account for the reason for use, whether recreational or for emotional coping. This statistic also does not take into consideration unexplained deaths or fatalities that may be related to opioids, but were not reported as such. Thus, the mortality rate in Texas, including Harris County, is likely to understate the true incidence of opioid-related deaths. Moreover, while the historical rate is low compared to other states and national rates, there is a rising trend towards opioid drug abuse and overdose across Texas.

Electronic cigarettes, also called e-cigarettes or vapes, are hand-held, battery-powered devices that vaporize liquid cartridges of nicotine (or other substances) into an inhalable vapor.[546] The vapor is not smoke, but rather an aerosol, and can be combined with flavoring agents. Increasing numbers of adolescents are using e-cigarettes, potentially because of the wide array of flavors and relative ease of consumption.[547] In Texas, an estimated 1.4% of adults use e-cigarettes on a daily basis, and 20.8% indicated they tried e-cigarettes in the past.[548] While the prevalence of adolescent e-cigarette use proves more difficult to measure, one recent assessment estimates 5% of teenagers aged 16 to 19 vape most days.[549]

The health impact of vaping remains under investigation. Chemicals identified in e-cigarette vapor include formaldehyde, acetaldehyde, and glycidol, all of which are known or probable carcinogens.[550,551] Vapes may also include acrolein, a weed killing substance that can cause acute lung injury and COPD, according to the American Lung Association.[552] The nature and quantity of chemicals in e-cigarette vapor depends strongly on the type of e-cigarette used and its effect depends on the frequency of use.[553]

In 2019, CDC announced an investigation into a possible connection between severe pulmonary disease and e-cigarette use following the identification of 94 cases of pulmonary illness that may be related to e-cigarettes.[554] As of October 8, 2019, 1,299 lung injury cases associated with the use of e-cigarette, or vaping, products have been reported to CDC from 49 states, the District of Columbia, and one US territory. Twenty-six deaths have been confirmed in 21 states.[555] Figure 3.8 maps the percentage of adults who have ever smoked electronic cigarettes in Harris County, by PUMA. The PUMA with the highest percentage of adults who ever smoked vapes, at 27%, was Sping-The Woodlands.[556] While changes in the lung and bronchi are associated with e-cigarette use, no substantial link between pulmonary illnesses and e-cigarette use have been established.[557] The potential for long-term injury or disability of lungs from vaping exists. E-cigarettes should not be promoted as an alternative to using tobacco products. More epidemiologic and health services research will be necessary to calculate the impact of e-cigarette use on public health.

Figure 3.8 Adults Who Used E-Cigarettes (%)

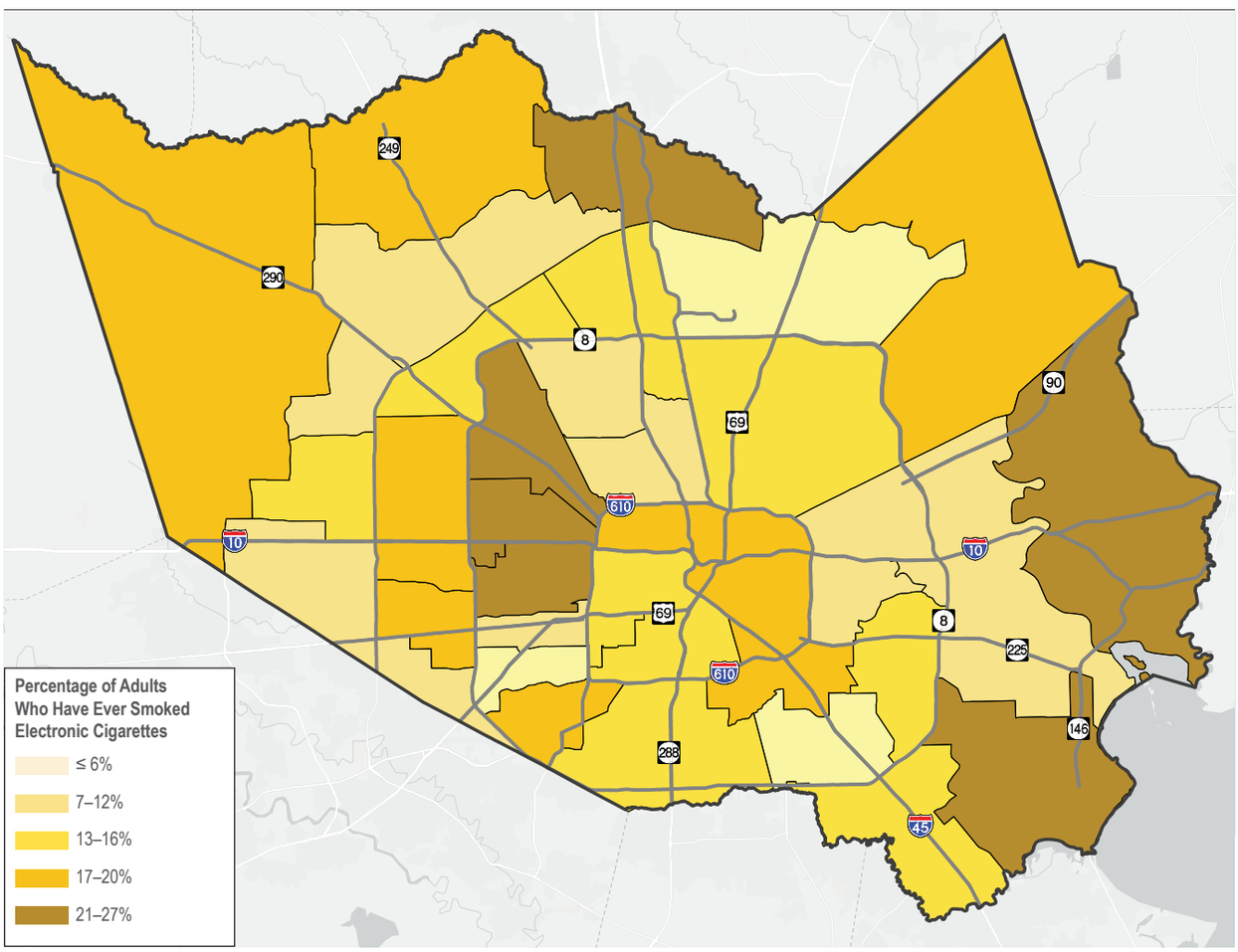


Figure 3.8 Percentage of Adults Who Have Ever Smoked Electronic Cigarettes by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.

Self-Inflicted Injury: Public Health and Health Care Infrastructure

In 2016, HCPH facilitated the establishment of the North Harris County Substance Abuse Prevention Coalition (NHCSAPC), one of many local coalitions working on addressing substance abuse. The coalition targets youth and young adults ages 12 to 25 in North Harris County communities using evidence-based prevention tools to educate and empower communities. NHCSAPC is one of five community coalitions for drug prevention in Harris County. The Tobacco Cessation program at HCPH facilitates education and cessation services in a four-week session format and support from the Texas Quitline. The program has updated its curriculum with information about alternatives to tobacco use, including the use of e-cigarettes.

Domestic and Sexual Violence

Domestic violence, sometimes referred to as intimate partner violence (IPV), is defined as "physical, sexual, or psychological harm by a current or former partner or spouse".[558] Men and women can be victims of IPV in heterosexual or same-sex relationships. However, women are more likely to experience physical injury and psychological trauma resulting from IPV.[559] Almost a third of female homicide victims are killed by their intimate partner, as reported in police records across the country. Women who experience IPV are more likely to experience depression, suicide attempts, and drug and alcohol abuse, as compared to women who are not abused.[560] While IPV results in physical and psychological harm for individuals, this intentional violence affects the health and well-being of families and communities.

According to CDC, intimate partner physical assault costs over $5.8 billion for direct mental health care, medical services, and lost productivity.[561] IPV is associated with other forms of violence experienced earlier in life or in adulthood, such as child abuse, suicide, and homicide. Sexual violence describes sexual activity that occurs without consent or under coercion. It includes sexual assault, rape and sex trafficking, a type of human trafficking where victims are forced to engage in sexual acts in exchange for money. Unfortunately, and despite recent steps taken by multiple partners (including Harris County Sheriff's Office, Harris County Attorney's Office, the Harris County District Attorney's Office, and others) to address this issue, Houston/Harris County is a human trafficking hub in the United States. In Texas, between 2007 and 2018 there were 8,505 human trafficking victims.[562]

Many of the individual, interpersonal, community, and societal level risk factors that affect the occurrence of IPV overlap with the risk factors for other health conditions and outcomes. Intimate partner violence, sexual violence, and sex trafficking are all forms of intentional injury that can be prevented. By addressing the societal and cultural factors that contribute to the likelihood of violence, the non-fatal and fatal injuries resulting from domestic violence can be prevented from happening.

Health providers who suspect that a patient or client may be a victim of abuse, neglect, or domestic violence, must follow an established protocol to disclose health information to appropriate government authorities as required and authorized by Texas law. Division and program policy and procedure also include a referral system to link victims and suspected victims to necessary health and social services. Several community-based organizations and health care institutions, like Texas Children's Hospital, have institutional policies to screen for IPV, often using varied validated tools.[563] The screening protocols vary dramatically regarding who is screened, who does the screening, how the patient is screened, how often the patient is screened, and which screening tool is used. Providers often only treat victims for acute injuries sustained from physical abuse and may not observe other signs that would trigger the use of a screening tool. The health care system can miss the reality and underlying causes of IPV in their patient population. Community organizations like the Harris County Domestic Violence Coordinating Council, work to reduce and prevent domestic violence in Harris County through education, coordinated housing, and community response.[564]

Child Abuse and Adverse Childhood Experiences

Child abuse refers to any act or series of acts by a parent or other caregiver that results in harm, potential for harm, or threat of harm to a child. **Adverse Childhood Experiences (ACEs) collectively describe all types of such abuse, neglect, or other traumatic experiences that occur during childhood and can lead to a lifetime of health and social impacts.** ACEs may be physical or psychological in nature. These experiences include witnessing or experiencing domestic violence, sexual abuse, and exposure to alcohol or drug abuse; having family members who experience severe mental health issues or are incarcerated; and emotional or physical neglect.[565,566,567]

According to the Texas Department of Family and Protective Services, the rate of substantiated child abuse in Harris County increased slightly from 4.6 cases



per 1,000 children in 2012 to 5.4 in 2017. However, as an estimated 8% of men and 6% of women have experienced childhood physical abuse, this likely underrepresents the true rate of abuse in Harris County.[568] The Texas Behavioral Risk Factor Surveillance System (BRFSS) included questions about ACEs only in the year 2015. They found that 26.2% of children had experienced one ACE and 19.9% experienced two or more ACEs.[569]

While ACEs may constitute injuries in themselves, they also have a lasting impact on the health of children throughout the rest of their lives. Children who experience ACEs are at increased risk for a variety of poor health outcomes, including psychological, social, and physical challenges. Children with ACEs demonstrate higher rates of mental health problems such as anxiety, depression, and suicide; engage in more high-risk behaviors including substance abuse and unprotected sex; and are more likely to contract cancer, heart disease, and diabetes.[570]

To reduce ACEs in the Harris County community, a number of agencies and partners are working on behalf of children and youth. These efforts are often multi-disciplinary in nature and help connect systems across the community. Public health agencies such as HCPH address the circumstances and risk factors that contribute to them. The Harris County Department of Education administers afterschool programs that provide dependable and safe environments for children who may have unstable home lives, and also provides in-school therapy for students who may be in or have recently experienced an ACE.[571,572]

Other county institutions also work to prevent ACEs. The well recognized Children's Assessment Center is a collaboration between the Harris County Commissioners Court and the Children's Assessment Center Foundation. The Children's Assessment Center provides psychotherapy and social work services for children and families in crisis, community education and professional training teaching individuals to identify sexual abuse, and forensic services for abuse survivors.[573] All of these services combined help to reduce the long-term effects of ACEs on exposed children. HCPH is also part of the statewide mandatory Child Fatality Review, a multi-agency group that reviews all child deaths to identify causes and improve system response to child endangerment.

The Harris Center in partnership with law enforcement provides jail diversion programs, substance abuse treatment, and outpatient mental health services to adults. The services provided at the Harris Center help to reduce the number of children exposed to family members who are incarcerated, addicted, or experiencing severe mental health challenges.[574]

Texas Children's Hospital has established the Child Abuse Pediatric Team, composed of pediatricians and allied health professionals who assess any suspected incident of child abuse or neglect. Additionally, Texas Children's Hospital leads the ACE Coalition, a multi-institutional collaboration of health and community leaders seeking to address and attenuate ACEs in Harris County through implementation of evidence-based interventions and programs in the community.[575]

Motor Vehicle, Pedestrian, and Bicycle Safety

Transportation accidents are one of the most frequent types of accidents that result in death. This includes accidents that involve motor vehicles, bicycles, and pedestrians on streets and highways. There is a great need to share data, investigate, and address motor vehicle safety, as well as pedestrian and cyclist safety. The age-adjusted death rate from motor vehicle accidents was 8.8 per 100,000 population in 2017 and has increased slightly since 2015. From 2015 to 2017, the age-adjusted death rate from motor vehicle accidents has increased from 7.9 to 8.8 per 100,000 population.[576] Several factors can lead to motor vehicle accidents: excessive speed, distracted driving, and driving under the influence of alcohol and drugs. Figure 3.9 shows the location and timing of traffic fatalities for Harris County in 2018. Note that the location of fatalities is spread throughout the county and concentrated where the highways are located. **Fatalities occur the most on Saturdays, at 3 AM.**

> The majority of fatalities due to traffic accidents are located along the major highways across Harris County (Loop 610, I-45, I-10, I-59, SH 288, and Beltway 8), where speed limits reach 65 miles per hour and above. Traffic fatalities occur most on Saturday through Sunday between midnight and 5 PM, Friday through Sunday between 5 PM and 10 PM, and Monday through Wednesday between 6 PM and 9 PM.

Pedestrian deaths increased by 27% from 2007 to 2016 in the United States. Texas ranked ninth highest in pedestrian deaths in 2016 with a fatality rate of 2.44 per 100,000 population. Harris County was the third highest county in the number of pedestrian fatalities in the country.[577] Limited complete sidewalks and no bicycle infrastructure (e.g. bicycle lanes) make walking and bicycling dangerous for people. Those who engage in these activities in non-ideal environments are more susceptible to injuries and fatalities. With its large population and large geographical area, hundreds of vehicles are driven on Harris County roads and highways every day. Many people have long commutes into, out of, and around the City of Houston. Roads are designed for fast driving, as many motorists drive well above speed limits and threat of ticketed traffic violations are not a deterrent.[578] The risk of pedestrian accidents and severe injury or fatality increases with higher vehicle speeds.

Pedestrian Safety and Stray Dogs

Another aspect to pedestrian safety includes dog bite injuries and stray dogs that pose perceived and/or actual safety concerns. In a Health Impact Assessment (HIA) conducted by HCPH in 2016, among community members surveyed in the East Aldine District area, when asked about neighborhood safety concerns, a majority of respondents were concerned about lack of lighting (88%), lack of sidewalks and trails (85%), traffic (75%), and stray dogs (68%).[579] Animal control efforts are therefore of utmost importance to ensure pedestrian safety and encourage outdoor physical activity.

CDC estimates about 4.7 million dog bites in the United States each year, with 800,000 of those resulting in medical care. Although over half of dog bites occur with dogs at home, with children being more likely to be bitten than adults, unrestrained dogs also can pose a serious threat and even death.[580,581] The Harris County area includes animal control agencies from 14 municipalities and city departments. Data from four of these organizations indicate that there were around 4,470 dog bites in Harris County. While this data only reflects four departments two of the departments handles a substantial portion of Harris County. In 2018, Harris County's Veterinary Public Health division investigated 2,320 reports of domestic animal bites.

Fall-Related Injuries

According to WHO, a fall occurs when a person unintentionally drops down to rest on the ground, floor, or other lower position. Injuries sustained from a fall can be fatal or nonfatal.[582] Falls are the leading cause of these nonfatal and fatal injuries for those 65 years and older. Millions of fall-related injuries are treated in emergency departments each year, which can be as serious as broken bones or a head injury. Falls cause pain, financial burden to individuals and the health care system, and reduce quality of life. Quality of life is affected when injuries from falls result in long-term disability or lead to a developed fear of falling, which can cause older adults to limit their activities, therefore inadvertently increasing their risk of falling.

There was a total of 14,797 reported inpatient and outpatient falls among residents 65 and older in 2016. In 2017, there were a total of 15,806 falls among the same age range, both in Harris County.[583] The age-adjusted death rate due to falls in Harris County between 2015 and 2017 was 10 deaths per 100,000 population. This is higher than the death rate in both Texas overall and the US, which are 7.6 and 9.2 per 100,000 respectively.[584]

There are several common risk factors related to falls, particularly for older adults:

- Age
- Poor balance
- Home hazards
- Vitamin D insufficiency
- Medications
- Vision impairment
- Foot or ankle disorder

Increasing age plays a role in balance, the decrease in bone mass and density, worsening vision, and the need to take medication for chronic disease and other conditions. Medication side effects can alter a person's cognitive and physical abilities, causing confusion, drowsiness, loss of balance, and diminished vision. These are risks of falling that can be addressed through identification and intervention. Falls and their related injuries are preventable. Interventions that focus on increasing physical activity, improving balance, building muscle mass, and addressing identified fall risks can prevent falls and the associated medical care costs.

> Home assessments are a simple approach to fall prevention. Trained health educators or health providers assess home environments to identify potential hazards that could pose fall risk to older adults. Sometimes a minor modification is all that is needed to remove a fall risk. Modifications like installing hand rails or grab bars, adding easily accessible stairway or hallway lights, firmly securing carpets, or simply removing clutter, can allow those susceptible to falls to live more freely without the threat of injury or permanent disability.

Several community health partner organizations offer fall prevention classes as well, including the Harris County Area Agency on Aging, Memorial Hermann and their Adult Trauma Division, and several Harris County precincts. The UTHealth Consortium on Aging promotes collaboration among the health care system, public health system, and academic landscape to provide quality health care for older adults in Harris County. The Elder Service Provider Network (ESPN) is a United Way interagency monthly meeting that offers personal interaction, professional development, and resources to individuals working to assist older adults. ESPN shares information that is useful for serving the population of older adults in Harris County, including linkage to care and relevant services.

At HCPH, the *Healthy Aging* program offers a fall prevention component to a health education and empowerment intervention for adults aged 60 and older. The program uses the evidence-based curriculum, *A Matter of Balance*, and facilitates an eight-week group health education intervention that focuses on reducing fear of falling and increasing physical activity. The program has partnered with Zibrio, a medical device company with patented technology to measure and improve balance among participants.

Figure 3.9 Traffic Fatalities

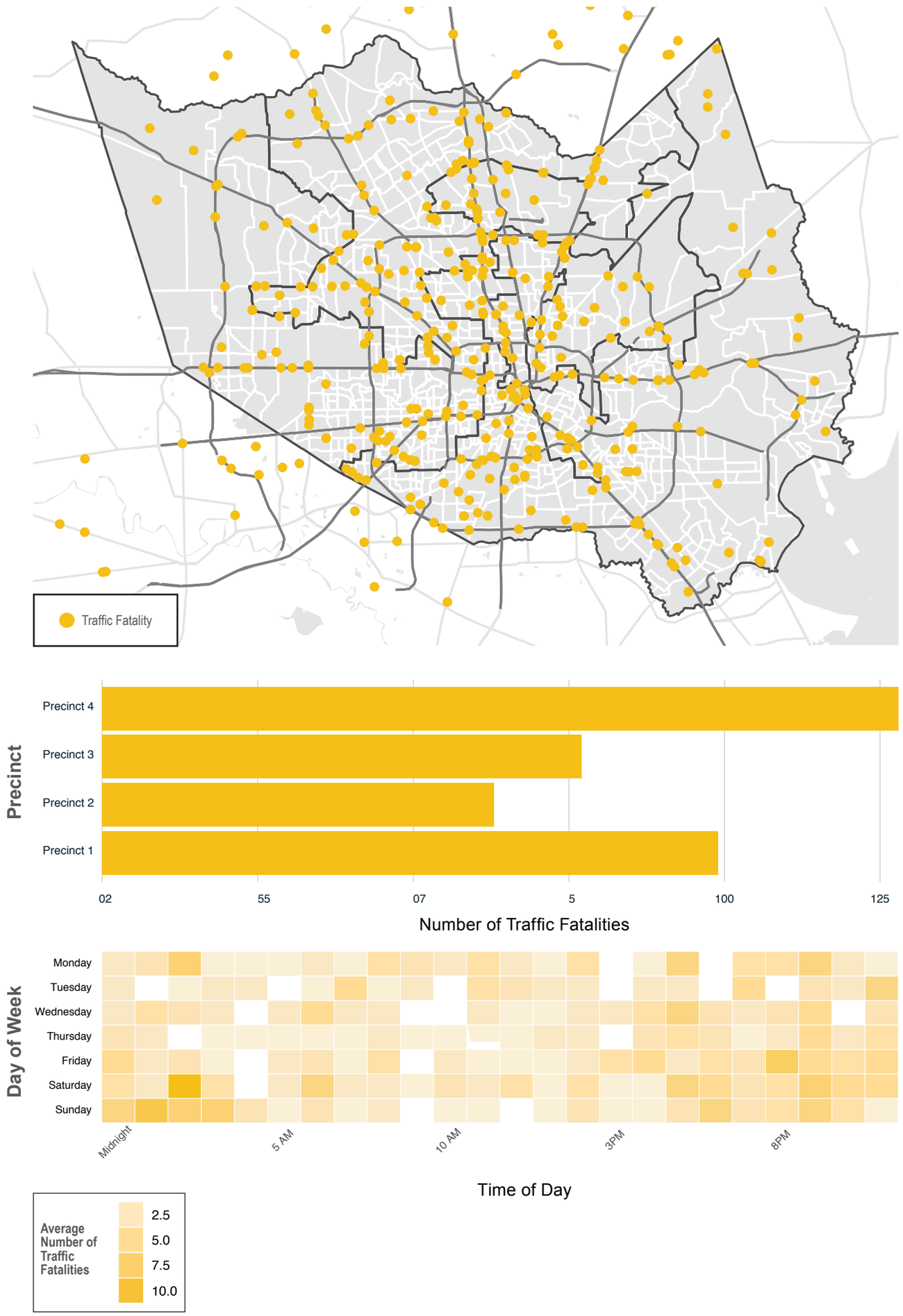


Figure 3.9 Location and Timing of Traffic Fatalities, Harris County, TX, 2018.
Source: Texas Department of Transportation, 2018.



INJURIES

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 12 Recommendations

- Support strategies that improve community safety and walkability through initiatives such as Complete Streets, pedestrian over/underpasses, pedestrian walk signals, etc.
- Support Harris County initiatives to increase the awareness of intimate partner violence, available resources, and potential referral options.
- Build Harris County capacity to acquire, analyze, and leverage local injury data.
- Partner with local school districts to provide education for a larger proportion of school-aged children and young adults about e-cigarette use to help prevent the risk of acute lung injury.
- Support multisector collaboration across Harris County government, including law enforcement, criminal justice, health, and others to address key issues such as violence, adverse childhood experiences, etc.



"More can be done to build community capacity to target gaps in areas like education, transportation, and mental health, with a focus on achieving health equity."





"Community health starts with families. Each family looks different and has different needs. This means our work must be inclusive and diverse."

—Dr. Susan Tortolero Emery
Senior Associate Dean, UT School of Public Health

13

Family Health

Families are the building blocks of community. The health of families, including fathers, mothers, infants, children, the very young, and the very old, is of critical importance to all those involved and promotes the well-being of the overall community. Maternal and child health is an established key indicator of the health status of the community as a whole and is a predictor of the health and productivity of future generations.[588] Healthy families means a healthier Harris County, but significant disparities and inequities exist across different communities within Harris County. By exploring existing data and initiatives, as well as the recommendations offered by existing partnerships and task forces, this study points towards opportunity for better health.

Figure 3.10 Improving Maternal Health

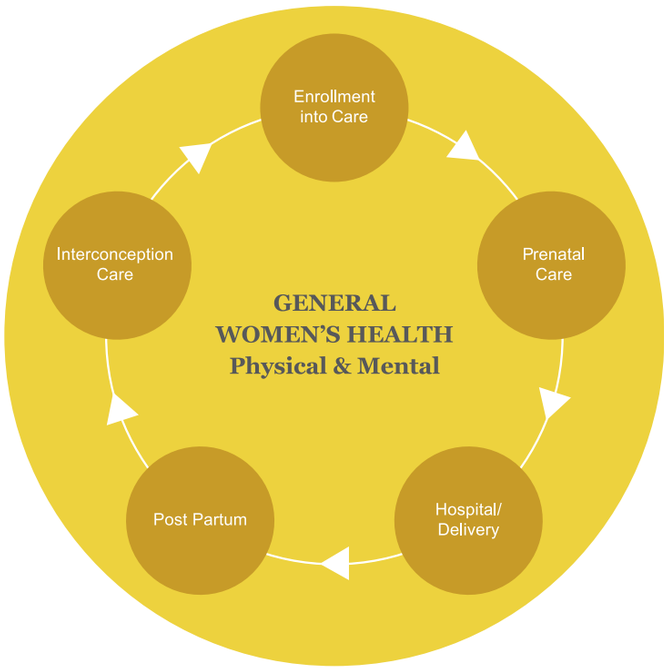


Figure 3.10 Improving Maternal Health in Harris County: A Community Plan.
Source: Adapted from Houston Endowment (2018).

Maternal and Child Health

Despite great progress in improving maternal and child health, data and other health outcome measures for Harris County indicate there remains significant need for improvement, especially in the areas of maternal and infant mortality and morbidity as well as family planning and reproductive health.

Many factors can affect maternal and child health, including, maternal age and health status. Women who are obese, have certain chronic diseases such as diabetes and high blood pressure, and women who are teenagers or over the age of 35 are all at a higher risk of complications during pregnancy.[589] Additional factors such as access to quality preconception and prenatal health care, tobacco use, substance abuse, and physical activity also contribute to maternal and child health.

Maternal and children's health is affected by more than just what happens during pregnancy and labor. As Figure 3.10 shows, there are multiple drivers of health that are interdependent on each other.

Maternal Mortality and Morbidity

Maternal mortality is defined by the WHO as a woman dying from pregnancy-related complications while pregnant or within 42 days of giving birth. Despite the community's extensive array of health care infrastructure, recent studies show Harris County is ranked worse than Texas and the United States for high rates of severe maternal mortality and morbidity. The rate of maternal mortality in Harris County doubled between 2007 and 2017, and is comparable to the trend in Texas (Figure 3.12).[592,593,594]

According to a 2018 study from the Houston Endowment and led by the UTHealth School of Public Health, severe maternal morbidity is described as unexpected complications of pregnancy or labor and delivery that result in significant, negative short- or long-term consequences to a woman's health.[595] Figure 3.13 shows the rate of severe maternal morbidity across Harris County. Specifically, Jersey Village-Willowbrook and Central Southwest-COH Fort Bend have high rates of severe maternal morbidity.

The rate of maternal morbidity in Harris County increased by 53% between 2008 and 2015, greater than the overall increase of 15% across Texas.[596] Despite these statistics, clear and accurate data about the health of women is lacking in Harris County, and indeed, across the country. This trend is particularly prevalent among Black women, regardless of their socioeconomic status.[597]

Figure 3.11 Lifecourse Initiative for Healthy Families

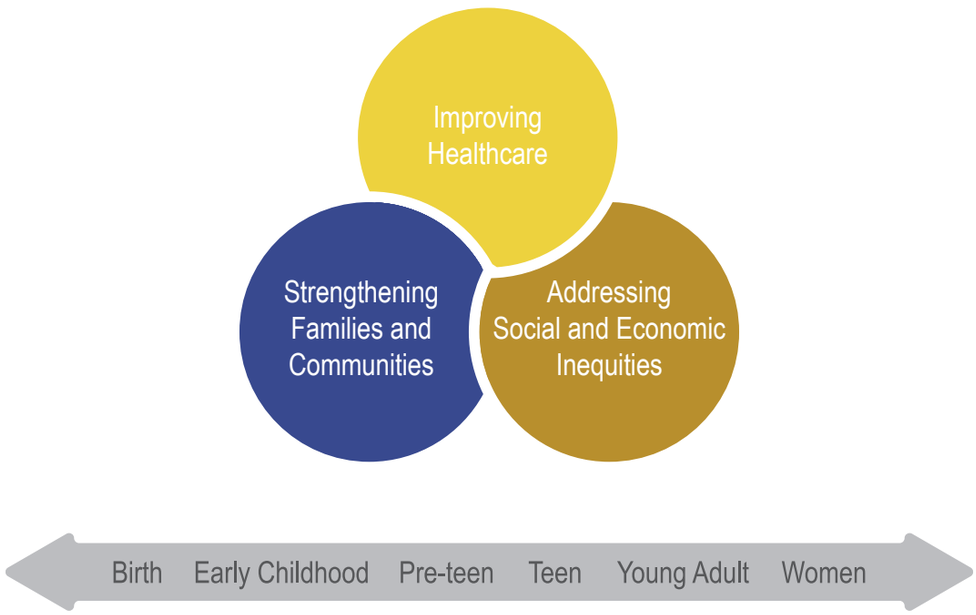


Figure 3.11 Lifecourse Initiative for Healthy Families.
Source: Adapted from Northern Manhattan Perinatal Partnership (Wrenn, 2009).

> The rate of maternal morbidity in Harris County increased by 53% between 2008 and 2015, greater than the overall increase of 15% across Texas.[596] ...This trend is particularly prevalent among Black women, regardless of their socioeconomic status.[597]

Figure 3.12 Rate of Maternal Mortality

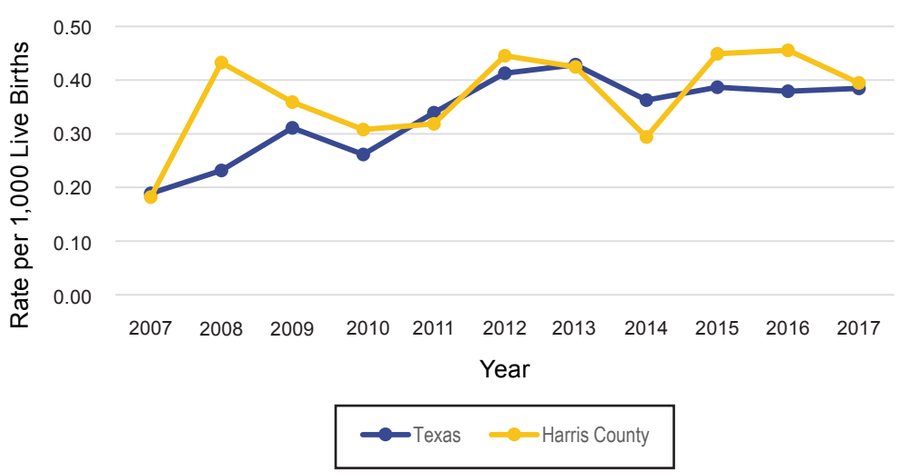


Figure 3.12 Rate of Maternal Mortality per 1,000 Live Births, Harris County, TX, 2007-2017.
Source: CDC WONDER, Centers for Disease Control and Prevention, 2007-2017.

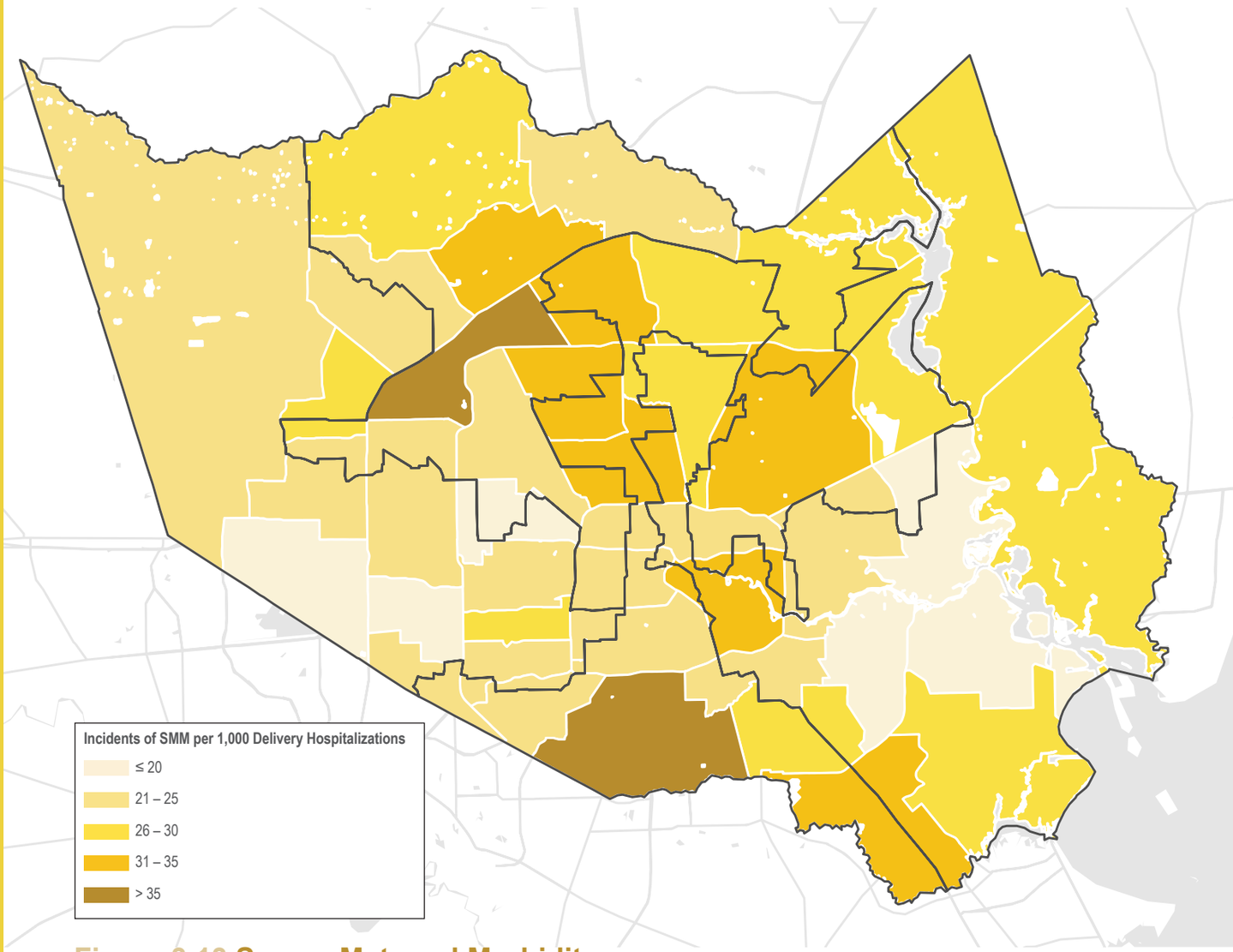


Figure 3.13 Severe Maternal Morbidity

Figure 3.13 Incidents of Severe Maternal Morbidity (SMM) per 1,000 Delivery Hospitalizations by Zip Code and PUMA, Harris County, TX, 2017.
Source: Center for Health Statistics, Texas Department of State Health Services, 2017.

Infant Morbidity and Mortality

Birth rates and infant mortality rates have been historically used as important measures of health status and social well-being.[599] However, in the past decade, critical measures of increased risk of infant death have been highlighted, including the prevalence of preterm delivery and low birthweight.[600] Infant mortality is a key marker of maternal and child health and has been used for decades as an important marker of the overall health of a population. It is associated with a variety of risk factors such as maternal health, pregnancy outcomes and socioeconomic variables. The United States has a high number of infant mortality rates (5.9 deaths per 1,000 live births) compared to other comparable industrialized countries (3.9 deaths per 1,000 live births).[601] According to CDC WONDER, the infant mortality rate was 5.9 deaths per 1,000 live births which was slightly higher but comparable to the Texas rate of 5.9 deaths per 1,000 live births (Figure 3.14).

Significant inequities in infant mortality rates also occur across racial and ethnic groups.[602] Black infants continue to die at more than twice the rate of White infants and is reflective of what is occurring in Harris County (Figure 3.14). Infant mortality is also associated with social vulnerability which means that programs for income support and social services could be effective tools to decreasing the high rate of infant mortality.[603]

The health of an infant is greatly influenced by factors outside of the medical care settings. The social, physical and economic environment plays a role in the quality of life of mothers and their infants. Examples of resources



"The rate of maternal morbidity in Harris County increased by 53% between 2008 and 2015, greater than the overall increase of 15% across Texas."

Figure 3.13 Severe Maternal Morbidity (continued)

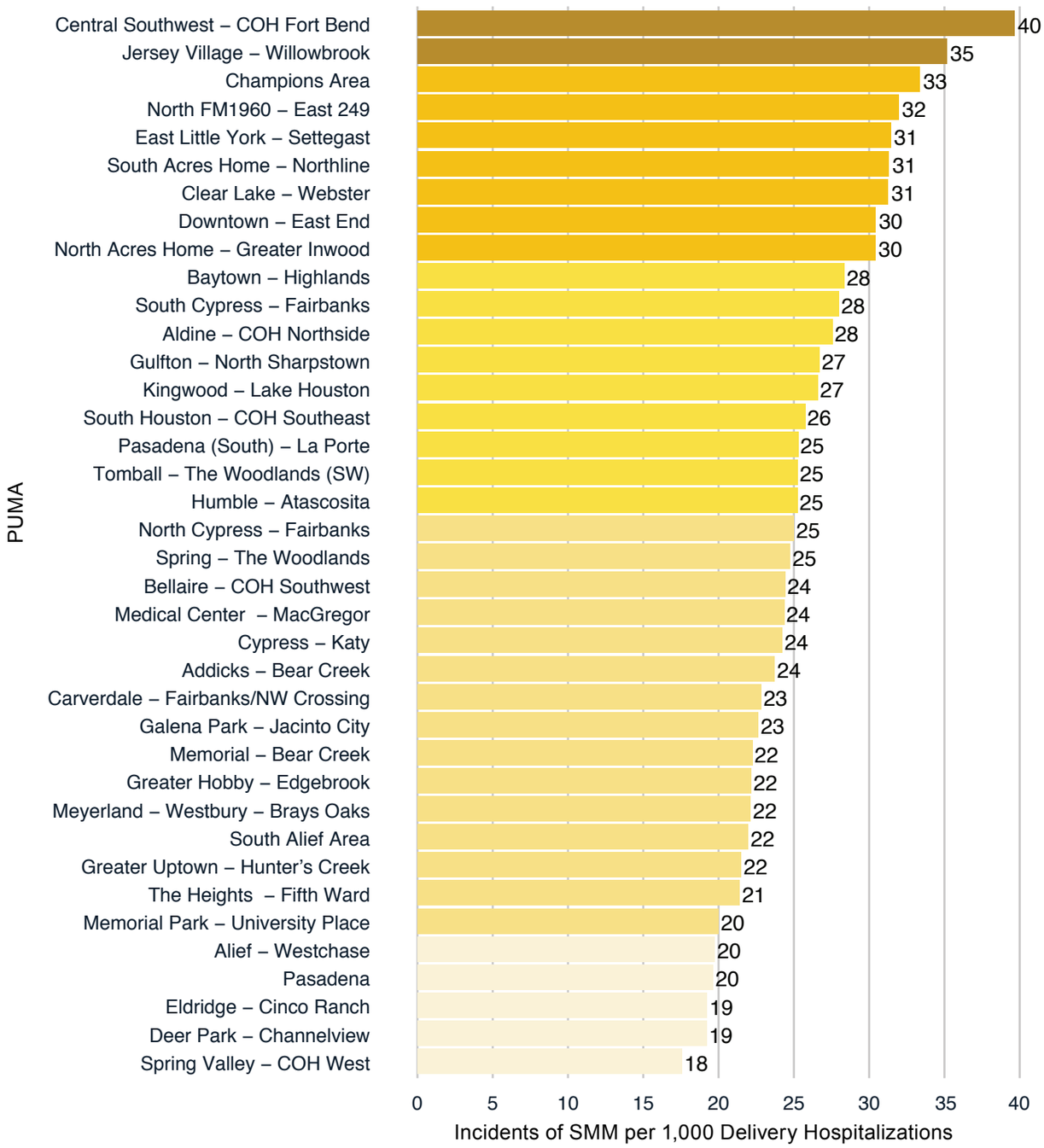


Figure 3.14 Infant Mortality

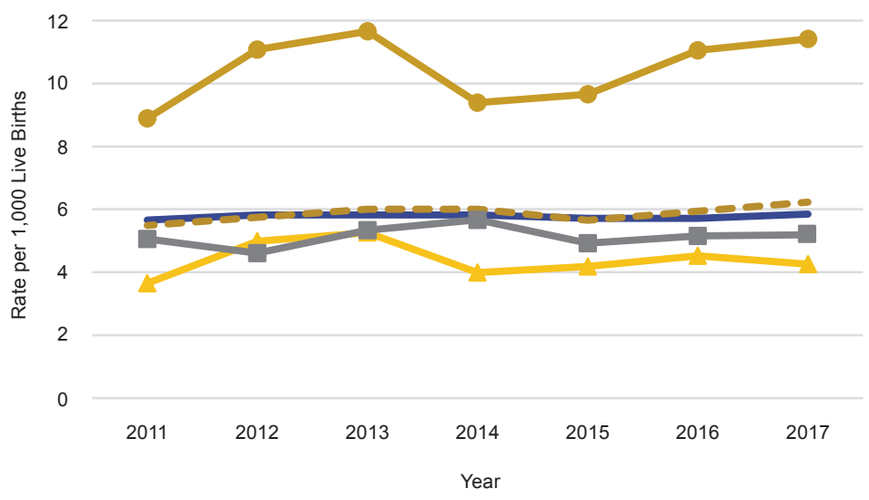


Figure 3.14 Rates of Infant Mortality per 1,000 Live Births by Race/Ethnicity, Harris County, TX, 2011-2017.
Source: CDC WONDER, Centers for Disease Control and Prevention, 2011-2017.

Figure 3.15 Preterm Births (%)

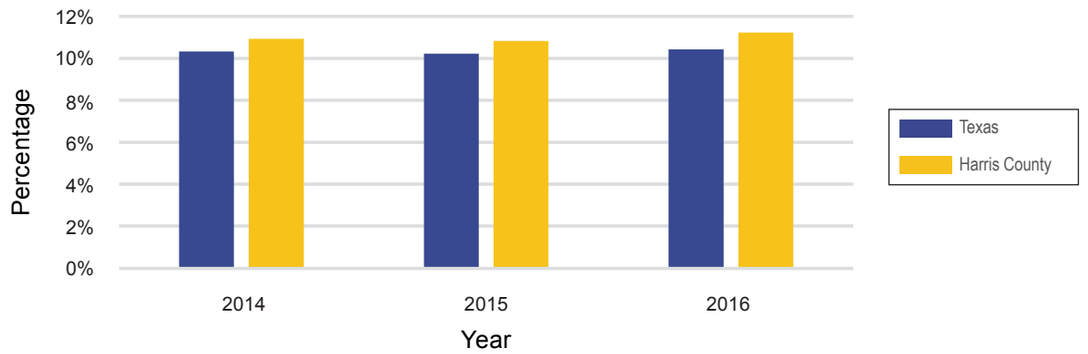


Figure 3.15 Percentage of Preterm Births, Harris County and Texas, 2014-2016.
Source: PeriStats, March of Dimes Perinatal Data Center, 2014-2016.

that influence an infant's health include affordable housing, public safety, availability of healthy foods, quality local emergency health services, access to public and community health programs for mothers and infants and environments free of life and health-threatening toxins.

Preterm Birth

Preterm birth is defined as a baby born before 37 weeks of pregnancy have been completed. Preterm babies have higher rates of death and disability which takes an emotional toll and can be a financial burden for families since these babies often require a significant amount of specialized care.[604] A 2018 report by WHO sited the United States as one of the top 10 counties with the highest number of preterm births.[605] In 2016, 9.8% of births in the United States, 10.4% in Texas, and 11.2% in Harris County (Figure 3.15).[606,607]

The March of Dimes estimates the cost to Medicaid of preterm and/or low birth weight (LBW) babies is nearly 10 times the cost of a healthy, full-term baby.[608] These costs include medical care, early intervention services, special education services and lost wages.[609]

Local health department investments in maternal and child health programs are associated with a significant reduction in rates of low birthweight.[610] Racial and ethnic differences in preterm birth rates exist with the percentage of preterm births among Black women being the highest (Figure 3.16).[611]

Low Birth Weight

Birth weight is one of the most significant predictors of infant health. LBW significantly increases (by 40 times) the likelihood of infant death during the first month of life; therefore, improvement in infant birth weight can contribute substantially to reductions in infant mortality rate. Over the past seven years, the average rate of LBW babies in Harris County has been 9%, a rate higher than that for the State of Texas at 8% (Figure 3.17).[612]

Black mothers are nearly 1.5 times more likely to have LBW babies than White or Hispanic mothers, in spite of having similar educational and income levels.[613] This is an area of active investigation by the Texas State Maternal Mortality Task Force and several other organizations in Harris County. Harris County is also behind the overall rates in Texas in early prenatal care. For instance, the percentage of women who received late (i.e., women who received care after the first trimester) or no prenatal care was 3% higher in Harris County than Texas over a four-year period (2012-2015).[614]

Figure 3.16 Preterm Births by Race/Ethnicity (%)

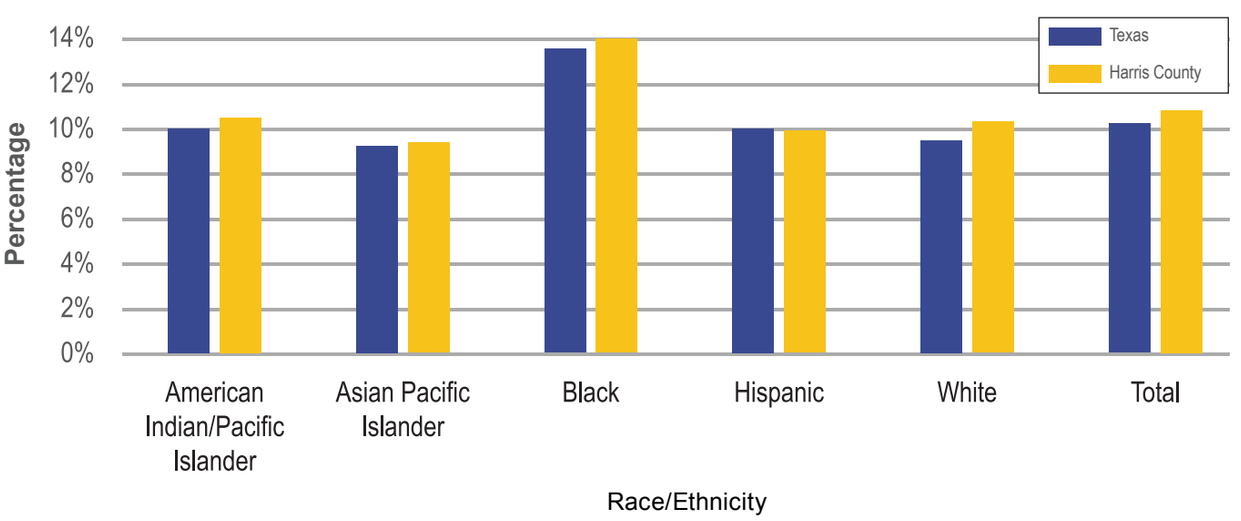


Figure 3.16 Percentage of Preterm Births by Race/Ethnicity, Harris County and Texas, 2014-2016.
Source: PeriStats, March of Dimes Perinatal Data Center, 2014-2016.

Figure 3.17 Infants Born With Low Birthweight (%)

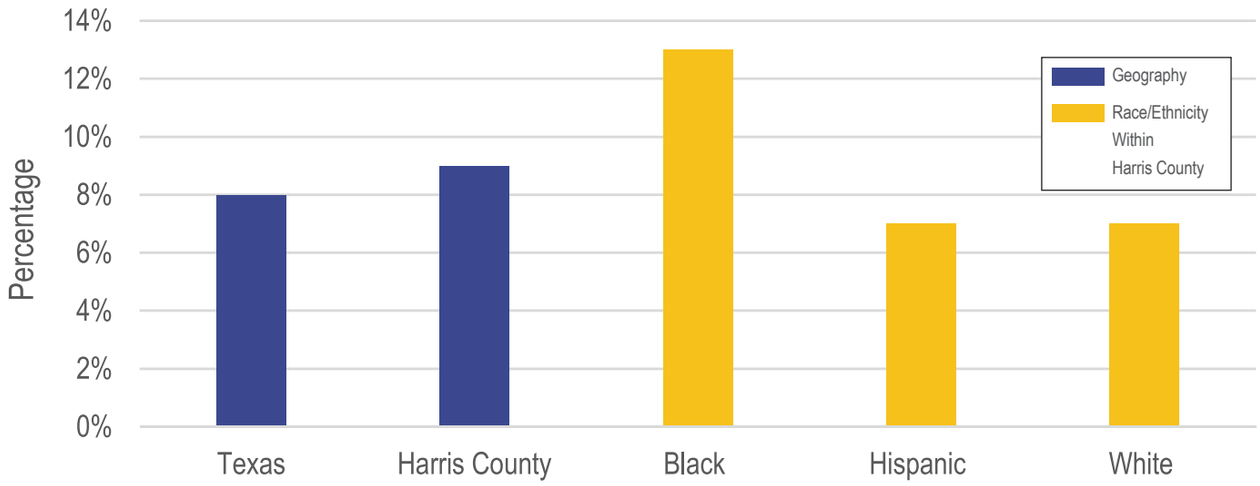


Figure 3.17 Percentage of Infants Born With Low Birthweight (<2500 grams) by Race/Ethnicity, Harris County, TX, 2009-2015.
Source: Center for Health Statistics, Texas Department of State Health Services, 2009-2015.

"The infant mortality rate is the number of infant deaths (under one year of age) for every 1,000 live births."

Family Planning and Reproductive Health

The state-funded *Harris County IMPACT Collaborative* supports pre- and inter-conceptual Black women with interactive workshops on pregnancy and conception, stress, physical activity and other modifiable risk factors for preterm birth and poor birth outcomes. Early and regular prenatal care is associated with healthy birth outcomes, which reduces the financial burden on the health care system.[615] Inadequate prenatal care is associated with preterm birth, which as aforementioned costs significantly more than term, healthy weight babies. Optimizing family planning is also related to the use of prenatal care, since it reduces unintended pregnancies. [616] Programs designed to reduce unintended pregnancies have been found to have substantial cost-savings for the health care system.[617]

Reproductive health refers to the health and well-being of women of child-bearing age, which includes pregnancy planning, fertility issues, birth control methods, and protection from STIs. Family planning allows women to space their pregnancies out, improving the health of both mother and infant and placing less burden on their family and resources.[618]

Breastfeeding Practices

Breastfeeding gives infants a healthy start, as it provides ideal nutrition and many needed antibodies, and can increase the bond between mother and infant.[619] Breastfeeding may also protect the infant from developing allergies, asthma, infectious diseases and ear infections, and has a protective effect against Sudden Infant Death Syndrome (SIDS).[620]

Breastfeeding supports the mother's health by protecting against breast, ovarian and endometrial cancers, and osteoporosis and bone fractures.[621] Breastfeeding reduces the risk of postpartum depression, heart disease and may delay fertility in those exclusively breastfeeding. Public health's goal is to increase both exclusivity and duration rates (i.e., feeding babies breast milk only for the first six months).[622]

The Healthy People 2020 goal is for at least 82% of mothers to breastfeed for any length of time and 25.5% of infants being exclusively breastfed for at least the first six months of age.[623] The Women Infant Children (WIC) program aims to increase both exclusivity and duration rates of breastfeeding. WIC serves to safeguard the health of low-income pregnant, postpartum, and breastfeeding women, infants, and children up to age five who are at nutritional risk by providing nutritious foods to supplement diets, information on healthy eating including breastfeeding promotion and support, and referrals to health care.

Figure 3.18 Breastfeeding of Babies in WIC

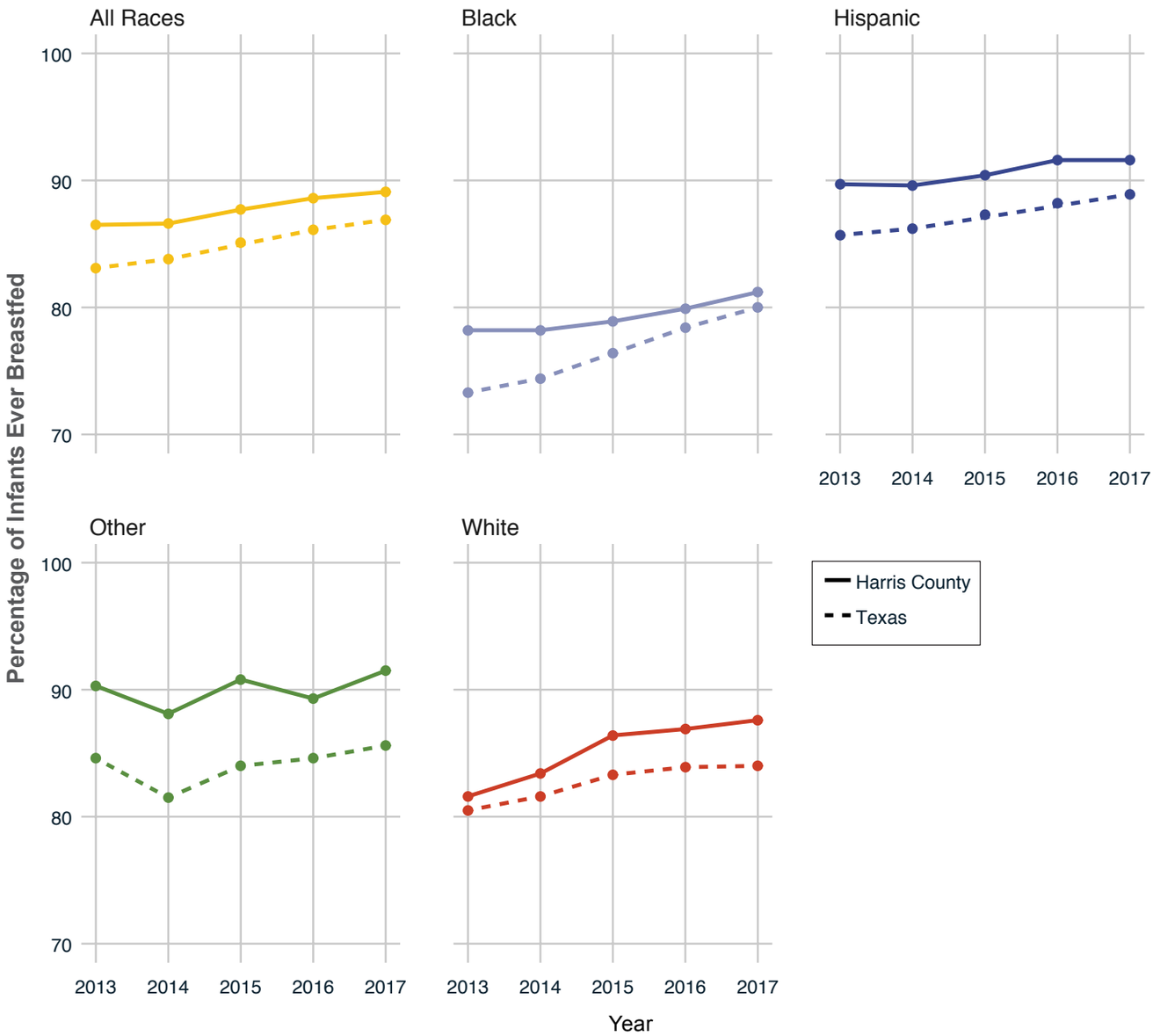


Figure 3.18 Annual Rates of Breastfeeding of Babies Enrolled in WIC by Race/Ethnicity, Harris County, TX, 2013-2017.
Source: Women, Infants and Children Program, Harris County Public Health, 2013-2017.

Data collected on rates of breastfeeding from WIC centers have shown that although breastfeeding rates have improved by 2017, Black women in Harris County are particularly vulnerable to lower breastfeeding rates, as seen in Figure 3.18. One of the gaps identified by Harris County's WIC staff members is a lack of collaboration between their program and their local hospitals. Many specialists wanted WIC to have more of a presence at the hospitals to expand the capacity of overworked lactation consultants. However, this was not feasible due to WIC's own staffing issues and lack of a relationship with the hospitals. Another barrier reported is the distance a woman must travel to a vendor to receive parental care and/or breastfeeding guidance and support (Figure 3.19).

Prenatal Care

Prenatal care refers to the medical care women receive during pregnancy. Prenatal care helps women achieve healthy pregnancies through screening and management of risk factors and health conditions, as well as education and counseling on healthy behaviors during and after pregnancy. To gain the full benefits of prenatal care, women should seek care during their first trimester of pregnancy. Expectant mothers should also be educated about the birthing process and basic infant parenting.

Harris County is also behind the overall rates in Texas in early prenatal care. While 66% of women seek early prenatal care in Texas only 55% of women in Harris County seek early prenatal care (Figure 3.20).

Figure 3.19 Distance to WIC Centers

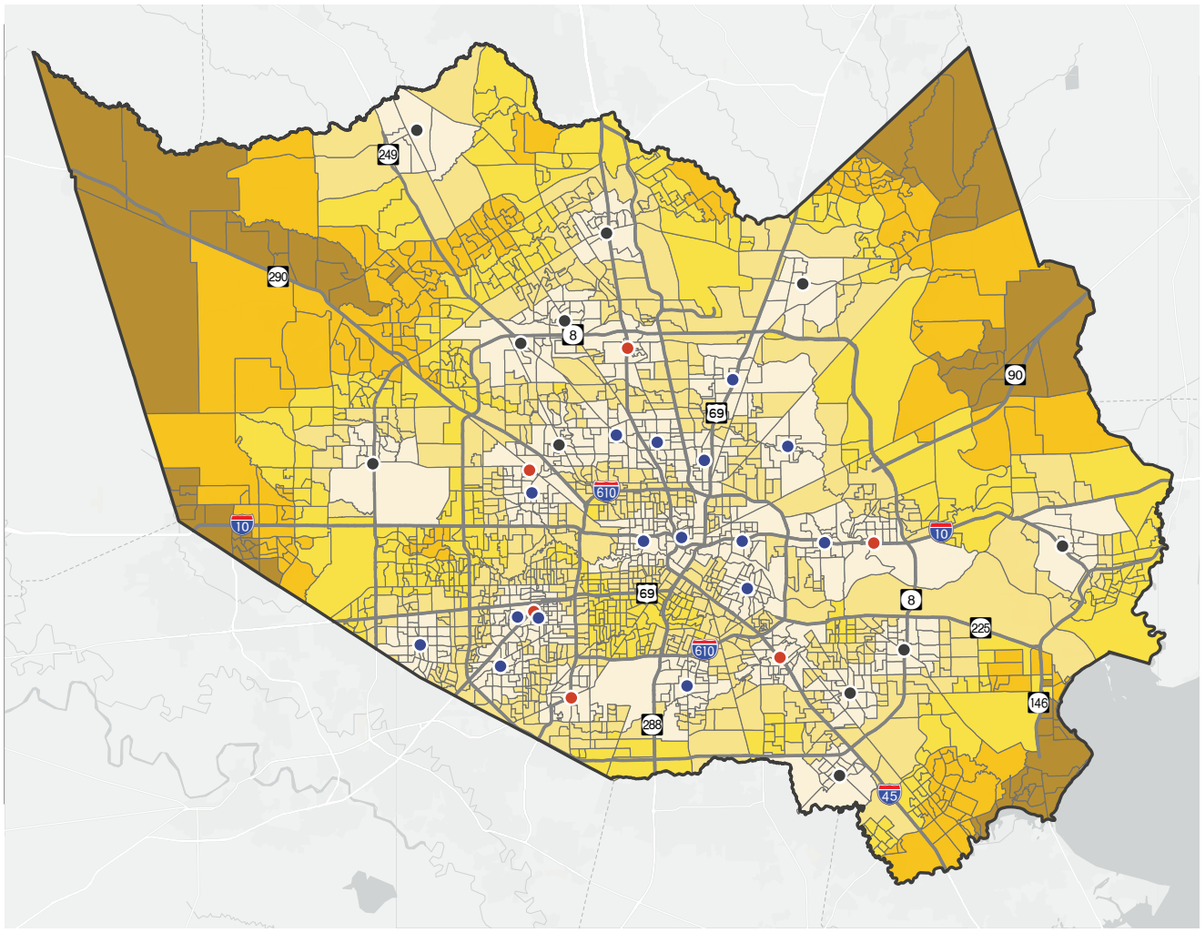


Figure 3.20 Women Who Received Early Prenatal Care (%)

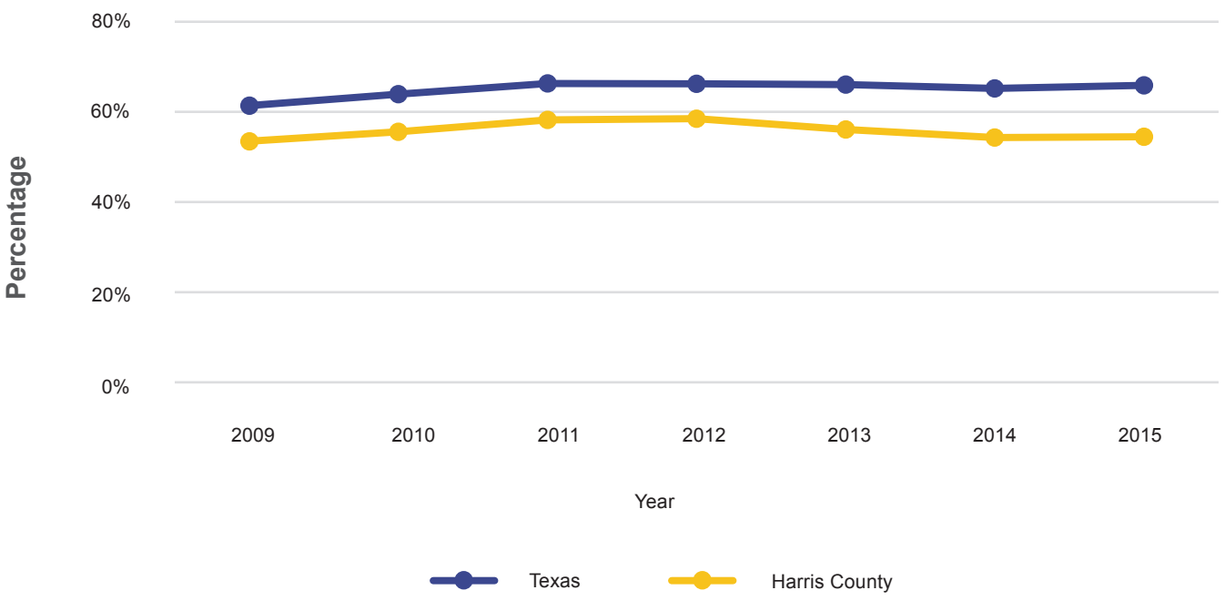


Figure 3.20 Percentage of Women Who Received Early Prenatal Care, Harris County, TX, 2009-2015.
Source: Center for Health Statistics, Texas Department of State Health Services, 2009-2015.

Figure 3.21 Women Who Received Late or No Prenatal Care (%)

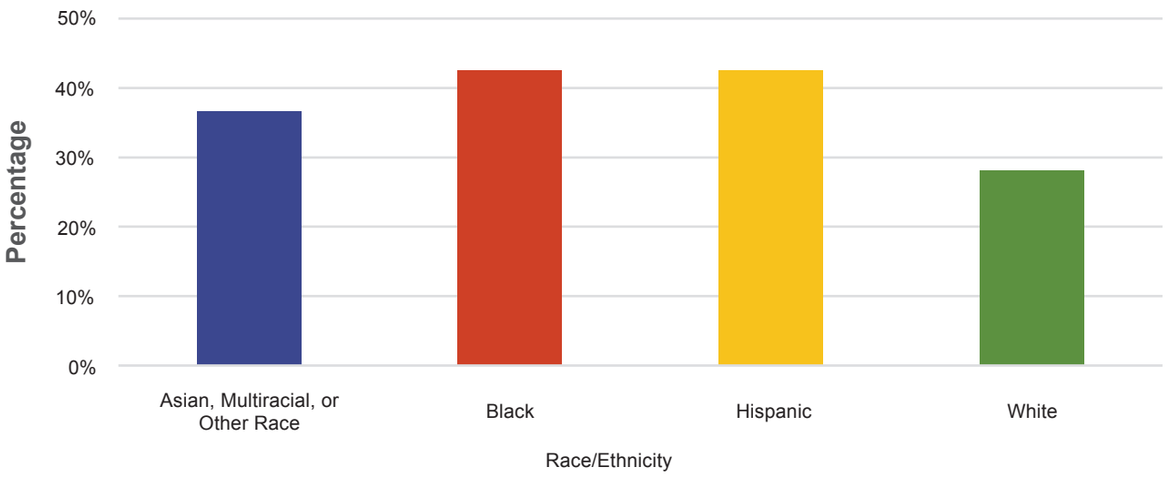


Figure 3.21 Percentage of Women Who Received Late or No Prenatal Care by Race/Ethnicity, Harris County, TX, 2015.
Source: Kids Count Data Center, Annie E. Casey Foundation, 2015.

While some neighborhoods in Harris County have better rates of early prenatal care entry, no zip code in Harris County meets the Health People 2020 goal of 77.9%. Currently, prenatal care services across Harris County are offered through obstetrician/gynecologists, family medicine/primary care doctors, WIC clinics, certified nurse-midwives, Planned Parenthood health centers and women pregnancy centers. Black and Hispanic women are at higher risk for seeking late prenatal care compared to White women. This trend can be seen in Harris County (Figure 3.21). There is also a racial disparity that exists in the quality of health care that women receive during pregnancy. About one in five Black and Hispanic women in Texas report poor treatment from hospital staff due to race, ethnicity, cultural background, or language.

Several types of barriers related to the poor utilization of prenatal care exist: financial constraints, including inadequate insurance; inadequate availability of maternity care providers; insufficient prenatal services in some sites routinely used by high-risk populations; experiences, attitudes, and beliefs among women that make them disinclined to seek prenatal care; transportation and distance to these centers; and inadequate systems to recruit hard-to-reach women into care.

Teen Births

Teen births are defined as births to mothers aged 15–19 years. Pregnancy and delivery can be harmful to teenagers' health and social and educational development. Babies born to teen mothers are more likely to be born preterm and at a low birthweight. Responsible sexual behavior, one of the ten leading health indicators of Healthy People 2020, reduces unintended pregnancies, reducing the number of teen births.[624] **Texas has the fourth highest teen pregnancy rate and highest repeat teen births in the country.**[625] Figure 3.22 depicts the average teen birth rates between 2011 and 2017 for Texas and Harris County, as well as for different race/ethnicity groups in Harris County. Hispanics and Blacks had more than two times the average teen birth rates compared to Whites.

Despite declines over the past 10 years, the state continues to struggle with reducing the number of these pregnancies, the majority of which are unplanned and unwanted. Teen pregnancy and childbearing bring substantial social and economic costs through immediate and long-term impact on teen parents and their children.

According to a recent study by the University of Texas Child and Family Research Institute, teen pregnancies have long-term financial implications for these mothers. **These outcomes cost Texas taxpayers more than $1.1 billion in 2010 and US taxpayers $12 billion each year.**[626] Robust prevention efforts are necessary to minimize the social and financial costs of teen pregnancies. Only 38% of teen mothers who have a child before the age of 18 will earn a high school diploma by age 22, and less than 2% earn a college degree by age 30. This educational disparity continues to impact teen mothers throughout their career. In particular, 67% mothers who move out of their family households live below the federal poverty line, and 63% rely on some public assistance within the first year of their child's life.[627]

Fortunately, the rate of teen births has decreased in the past seven years across the United States.[628] At the national level, effective programs include sexuality education programs, youth development programs, abstinence education programs, and programs specifically designed for diverse populations and settings. Still, data indicates that Black and Hispanic women in Harris County are more likely to become mothers at a younger age than White teens (see Figure 3.22). Children's Health Insurance Program (CHIP) perinatal coverage does not cover complications from pregnancy or any other medical services for postpartum women beyond two postpartum visits (e.g., family planning is not covered).

Figure 3.22 Women Who Received Early Prenatal Care (%)

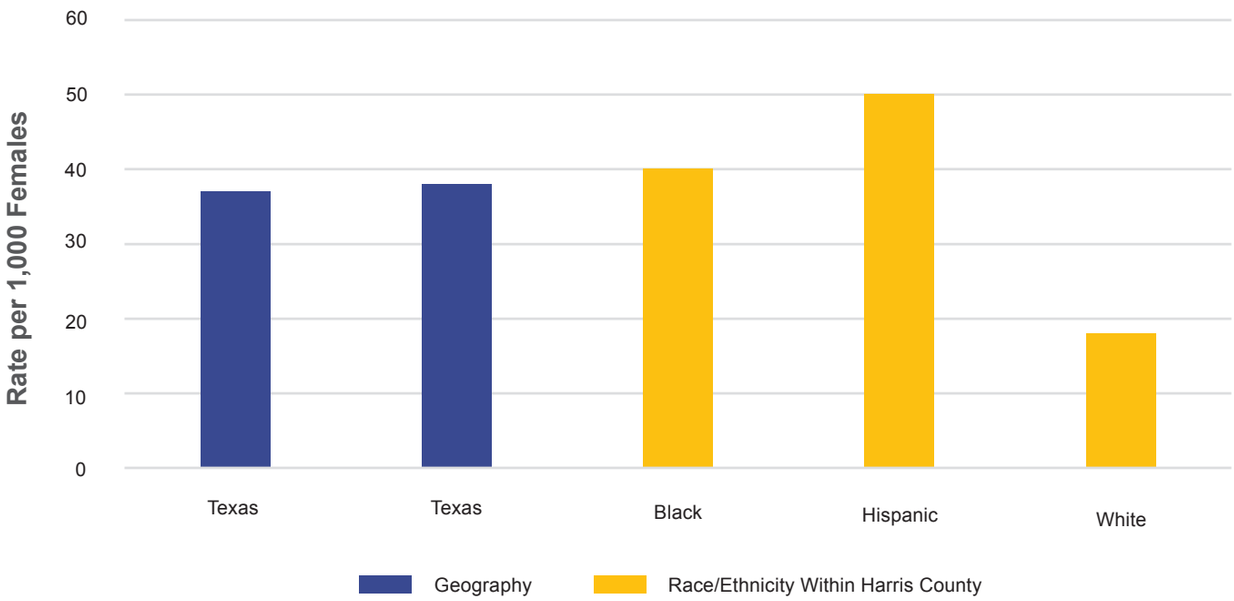


Figure 3.22 Average Teen Births per 1,000 Females (15-19 Years of Age) by Race/Ethnicity, Harris County, TX, 2011-2017.
Source: National Vital Statistics System, National Center for Health Statistics, Centers for Disease Control and Prevention, 2011-2017.

Figure 3.23 Children Without Insurance (%)

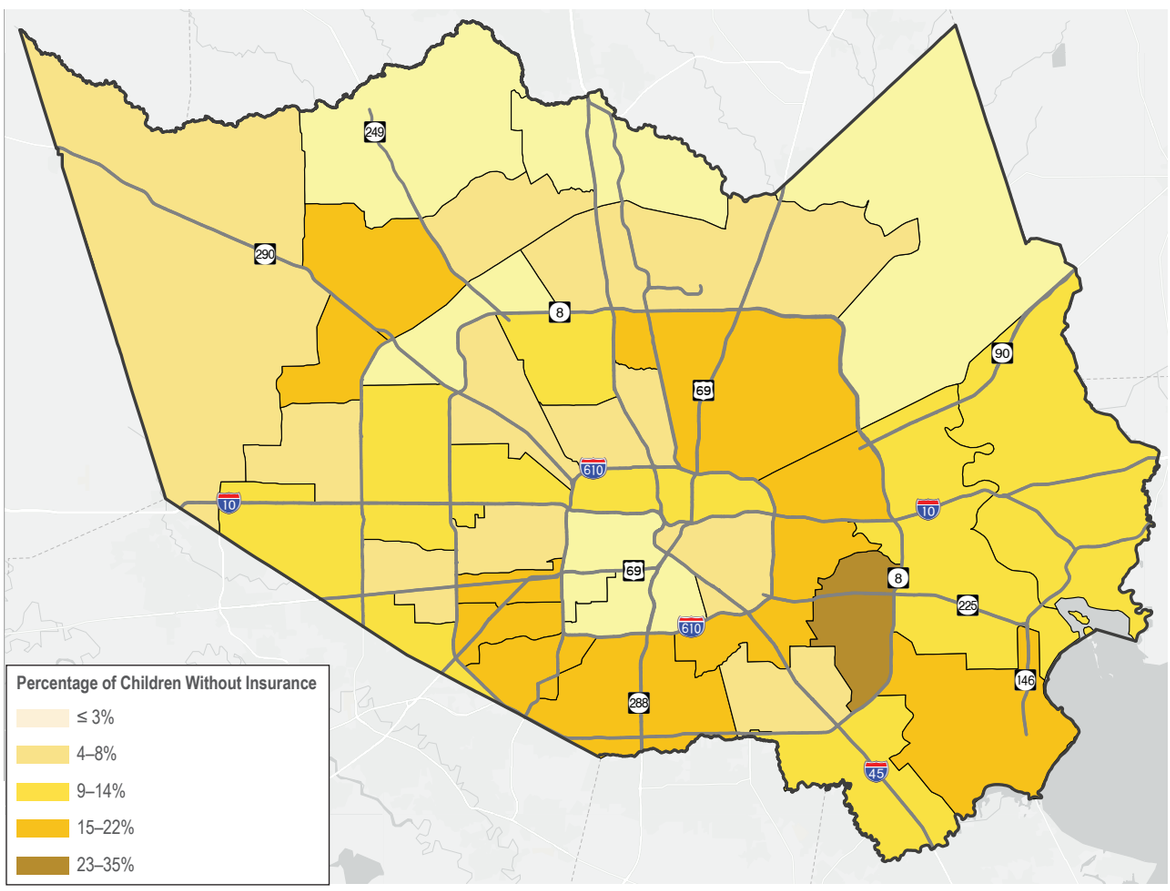


Figure 3.23 Percentage of Children Without Insurance by PUMA, Harris County, TX, 2018.
Source: Health of Houston Survey, The University of Texas School of Public Health, 2018.



Men's Health

Men have an important part to play in society and, not surprisingly, heathier men live longer and healthier lives. Unfortunately, the health of men is often overshadowed despite the fact that men are more likely to engage in unhealthy behaviors and have a lower life expectancy compared to women.[632] In Harris County, men were more likely than women to engage in risky behaviors such as binge drinking in the past month (23% vs 15%) or be current tobacco smokers (14% vs 13%). Poor health status, premature death and disability among men adversely impacts families, spouses, and communities. For example, almost half of older widows who live in poverty were not living in poverty before the death of their husbands.[633]

The leading causes of death among Americans are heart disease, cancer, and unintentional injury.[634] Men die at much higher rates than women from these causes.[635] Some variables influencing these rates are low health literacy, lack of insurance, societal male normal, and cultural incongruence. In Texas and Harris County, access to health care due to lack of insurance is a major obstacle that makes access to health care challenging for men. In Harris County, while 81% of females are insured only 78% of males are insured.

In the United States, prostate cancer is the second leading cause of cancer death and the second most common diagnosed cancer after skin cancer.[636] The rate of death due to prostate cancer is higher in Harris County (19 per 100,000) than overall in Texas (18 per 100,000).[637] Even though somewhat controversial, one study showed that Prostate-Specific Antigen (PSA) screening was associated with a 20% reduction in death due to prostate cancer.[638] In Harris County, only 40% of men who were 40 or older (the age by which it is recommended a man have a PSA screening completed) had a PSA screening test.

While more attention and funding often are directed towards maternal and child health, a fully healthy and equitable community in Harris County will require specific programs and services that target men and their health as well. Additionally, due to the higher likelihood of engaging in riskier behavior or conditions whether physical or mental health in nature that may impact men disproportionately, health education campaigns and other interventions specifically focusing on men would most certainly help address their health-related needs.

Disabilities

Healthy People 2020 offer objectives to promote the health of people with disabilities, prevent secondary conditions and eliminate disparities.[639] Impacting all communities, 61 million adults in the United States currently live with a disability and 7% of children live with a developmental disability.[640] According to the American Community Survey, there were 414,213 (9.2%) people living with a disability in Harris County between 2013 and 2017. In Harris County, 3.3% of children live with disabilities and 11.4% of adults.

Nearly half of respondents for *Talking Transition* stated that safety for persons with disabilities is either poor or terrible, and a third thought it was getting worse. While the authors acknowledge more can be said about the importance of studying the needs of persons living with disabilities, they recognize this is actually a diverse group of people with varying need needs. For example, a person may suddenly become wheelchair-bound due to a traumatic brain injury from a fall or a motor vehicle accident compared to another individual who may have a developmental disability that has impact on their health and well-being from birth. The health and social needs of the two individuals will likely be different and their care must thus be planned for with these differences in mind.

NACCHO found that more LHDs have programs that are inclusive of people with disabilities compared to just four years ago. For example, in 2018 it was noted that 89% of LHDs had preventative health services that were inclusive of people with disabilities compared to 26% in 2014. The report indicates that LHDs engage with people with disabilities through community health surveys (85%), community forums (51%), focus groups (49%), key informant interviews (37%), and other methods (4%). [641]



Locally, many important programs addressing the needs of the disability community are in place. However, the programs do not have enough resources to handle the myriad of needs that may be present within a community as large as Harris County. The Houston Mayor's Office for People with Disabilities, for example, provides several of the aforementioned outreach efforts and services such as free visual fire alarms for the deaf and hard of hearing and free legal service for people with disability. It is a prime example of a program ensuring that people with disabilities have equal opportunities and inclusion. Advancing health equity for all members of the Harris County community is a key tenet of this health study.

Conclusion

The health of mothers and children is important to Harris County because it reflects the health of the community and predicts the health and productivity of future generations. Although comparable to state and national rates in certain health indicators, distinct disparities remain in Harris County that disproportionately impact Black Harris County residents. This report highlights areas for potential improvement. Specifically, the low percentage of early prenatal care for women compared to state numbers and the high rate of infant mortality in relation to the state and national average. The recommendations offered to improve the health of mothers and children in Harris County provide a comprehensive approach to address upstream determinants of poor health outcomes.

"LBW significantlly increases (by 40 times) the likelihood of infant death during the first month of life. "



FAMILY HEALTH

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 13 Recommendations

- Work with Harris County Department of Education and other partners to implement evidence-based programs for teen pregnancy prevention and safe sex practices for Harris County, with a particular emphasis on those who are disproportionately impacted.
- Enhance the use of mobile outreach and other innovative practices to help ensure all families have access to nutritious and affordable foods, targeted health education, and other information about social service programs, etc.
- Invest in important care extenders such as visiting nurses, outreach workers (e.g., promotoras), and others who can provide health-related support and other assistance to all residents, with a particular emphasis on those who are disproportionately impacted.
- Support local efforts to streamline and expedite enrollment of under and uninsured community members into eligible coverage programs.
- Advocate for the State to simplify and expedite enrollment into Medicaid, The Children's Health Insurance Program, Healthy Texas Women, and other programs that support the under and uninsured.
- Support countywide participation in local and state coalitions that focus on family health.
- Support and expand mental health and substance abuse resources in Harris County to ensure seamless referrals that include feedback and data sharing between women health care providers and others.
- Build Harris County capacity to acquire, analyze, and leverage maternal and infant mortality and morbidity data.



“There needs to be better coordination between Harris Health, Harris Center, and the city/county health departments so that services are seamless to the residents and patients of Harris County.”

- Greg Bernica,
Executive Vice President and CEO, Harris County Medical Society





"The battle against emerging and existing infectious diseases will be won by a team of public health professionals, accessible data, and engaged communities who are focused on protecting the health and safety of all. "

—Dr. Oscar Alleyne
Epidemiologist/Chief of Programs and Services,
National Association of County and City Health Officials

14

Infectious Diseases

Infectious diseases consist of a wide spectrum of diseases that can include anything from rare, deadly diseases such as Ebola virus, to more common illnesses like foodborne diseases (e.g., E. coli, shigellosis, and norovirus) and respiratory conditions (e.g., influenza, pneumonia). These diseases can be contagious, can be passed from one person to another, or spread through the air, water, food, soil, or even by animals.

With the advent of antibiotics and vaccines, many formerly endemic infectious diseases have become exceedingly rare or eliminated altogether. Infectious diseases for which antibiotics are not effective or no vaccine exists, however, have proven exceedingly complex to control or prevent. Addressing Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS), vaccine hesitancy, antibiotic resistance, large-scale foodborne outbreaks, and so many other infectious-disease conditions requires more emphasis on collaboration and aligning multi-partner strategies, and less focus on finding the right medication or lab test.

As such, infectious disease challenges of today underscore this study and others' call to action on increasing communication, collaboration, and coordination for agencies that impact health.[642] Infectious disease surveillance is a core function of public health. Public health epidemiologists are 'disease detectives' who investigate suspected cases of disease and act as the eyes and ears of public health. Through their hard work, public health professionals are able to measure the rates of diseases and look for spikes, which often indicate the presence of a disease outbreak.

Figure 3.24 **One Health**

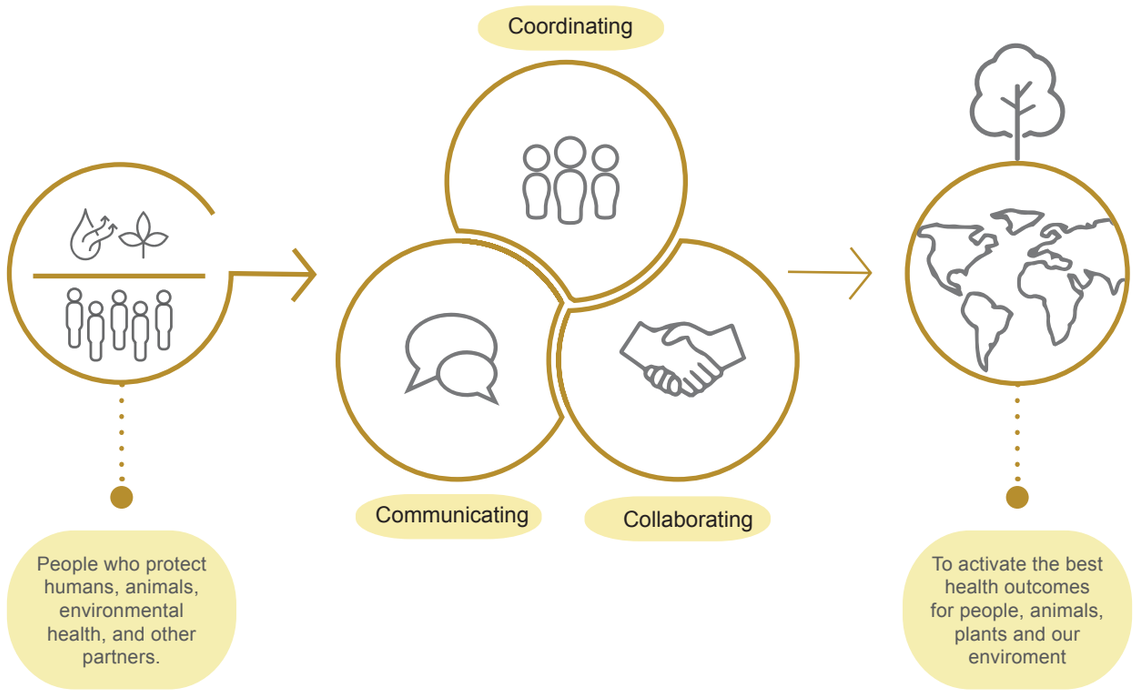


Figure 3.24 One Health.
Source: Adapted from National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention.

HCPH has been recognized for its use of a "One Health" approach, which is a concept that recognizes that the health of people is connected to the health of animals and the environment (Figure 3.24).[643] Successful public health interventions require coordination, communication, and collaboration with human, animal (including insect), and environmental health sectors.

Zoonotic Diseases

Zoonotic diseases are infectious diseases caused by viruses, bacteria, and parasites. They are transmitted between animals and humans. Because animals provide many benefits to humans, including companionship, and have been shown to improve one's overall health and mental health, it is important for public health to take a One Health approach to understand the complex relationships between animals and humans.[645] People may come into contact with animals while doing outdoor activities (e.g., hiking, walking, camping), at a zoo or petting zoo, county fair, or at home with their pets. Animals are also an important source of food for humans, such as meat, dairy, and eggs. While animals provide these substantial benefits to humans, they can also carry harmful viruses, bacteria, parasites, and fungi.[646] Scientific experts estimate about 60% of known infectious diseases are spread from animals to humans and 75% of emerging infectious diseases are spread from animals.[647]

Rabies is one example of a zoonotic disease which has a case-fatality rate of almost 100%, stressing the public health importance of prevention.[648] There were over four thousand cases of rabies in animals and two human cases in the United States in 2017.[649] In 2018, the total number of animals tested for rabies in Texas was about twelve thousand, with 695 (6%) testing positive. Harris County had 4% of the positive animal cases of rabies in the state, with 28 cases out of 1,494 tests that were possible for rabies; all 28 cases were from encounters with bats.[650] Dogs can also transmit rabies to humans through a bite. Rabies prevention through animal control, enforcement of rabies quarantine laws and regulations, and providing post-exposure rabies risk assessment to the medical community and residents has been instrumental in reducing this fatal disease in Harris County. Though the last human case of rabies in Harris County was in 2006, this rare disease is one that public health and health care providers alike remain vigilant in their work.

Tuberculosis

Tuberculosis (TB) is one of the world's deadliest diseases, with a global burden of nearly 10 million cases annually and 1.3 million deaths in 2017 alone.[651] The disease is caused by Mycobacterium tuberculosis bacteria and primarily affects the lungs but can infect other organs. It is spread through airborne droplets from a cough or sneeze of an infected person. Although a person may have a TB infection, not everyone becomes symptomatic.

Those with TB infection can progress to TB disease and show signs and symptoms. Only those with active TB have the ability to spread the bacteria to others. If left untreated, TB can be fatal. From 2013 to 2017, case rates for Harris County remained consistently higher than the national average, ranging from 6.0 to 7.2 cases per 100,000 persons,

Table 3.3 Tuberculosis Case Counts and Rates

	2013	2014	2015	2016	2017
Harris County Cases	286	320	326	283	280
Harris County Rate*	6.6	7.2	7.2	6.1	6.0
Texas State Rate*	4.6	4.7	4.9	4.5	4.0
United States Rate*	3.0	3.0	3.0	2.9	2.8

Table 3.3 Local and State Tuberculosis Case Counts and Rates, Harris County, TX, 2013-2017.
Note: *Rates per 100,000.
Source: TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services, 2013-2017.

as can be seen in Table 3.3. During that time frame, 2017 showed the lowest case rate per 100,000 for Harris County (6.0) and the United States (2.8). Even so, the United States is not on target to meet its national TB elimination goal of less than one case per one million persons annually, unless there are greater investments and targeted efforts.

In the US, an estimated $463 million was spent on TB cases in 2017 for X-rays, testing, and treatment. For the treatment of one case of TB susceptible to the normal drug regimen, the cost of treatment is about $19,000.[652] Directly Observed Therapy (DOT) is the standard of care for treatment of TB. With DOT, health care workers observe patients taking their medications each and every time on a daily basis. As can be surmised, this is very labor-intensive. In 2014, HCPH was one of the first public health agencies in the nation to adopt Video Directly Observed Therapy (VDOT) as an innovative, alternative treatment practice for TB disease and infection to offer patients increased flexibility while reducing the enormous cost of providing traditional DOT. It works via an application in which a patient uploads a recording of themselves taking their medications. The video is reviewed by a health care worker, reducing the need for travel. HCPH analyzed the costs averted by this innovative technology and found that Harris County saved over $180,000 from FY2014-FY2017. The HCPH VDOT program was recognized by CDC as a model program initiative in 2016 for its transformative potential for public health practice.

Currently, HCPH and HHD both have separate TB Elimination programs. As such, opportunities exist to improve TB surveillance and prevention through closer coordination and even potential integration of the programs. For all Harris County residents to enjoy the benefits afforded them through VDOT, for example, it would require two separate contracts, two separate programs, and two separate administrative staff.

Human Immunodeficiency Virus and Other Sexually Transmitted Infections

HIV is a virus that attacks certain immune system cells and affects the body's ability to fight off infections. Over time the damaged cells make the body more vulnerable to infections, making it increasingly difficult to fight off any infections acquired. There is no cure for the virus; however, with appropriate medical care, it can be controlled. The use of preventive therapy known as Pre-Exposure Prophylaxis (PrEP), is one of the most effective tools available.

Today, approximately 1.1 million people in the US are living with HIV, with nearly 39,000 newly diagnosed in 2017.[653] Figure 3.25 summarizes the burden of HIV in Harris County in terms of location and race/ethnicity. Black and Hispanic populations tended to have the highest number of new HIV diagnoses in 2017. Compared to 2013, Black and Hispanic populations also tended to experience the biggest increase in the rate of people living with HIV, as indicated in Figure 3.26, with some neighborhoods seeing substantially higher counts.

Figure 3.25 New HIV Diagnoses

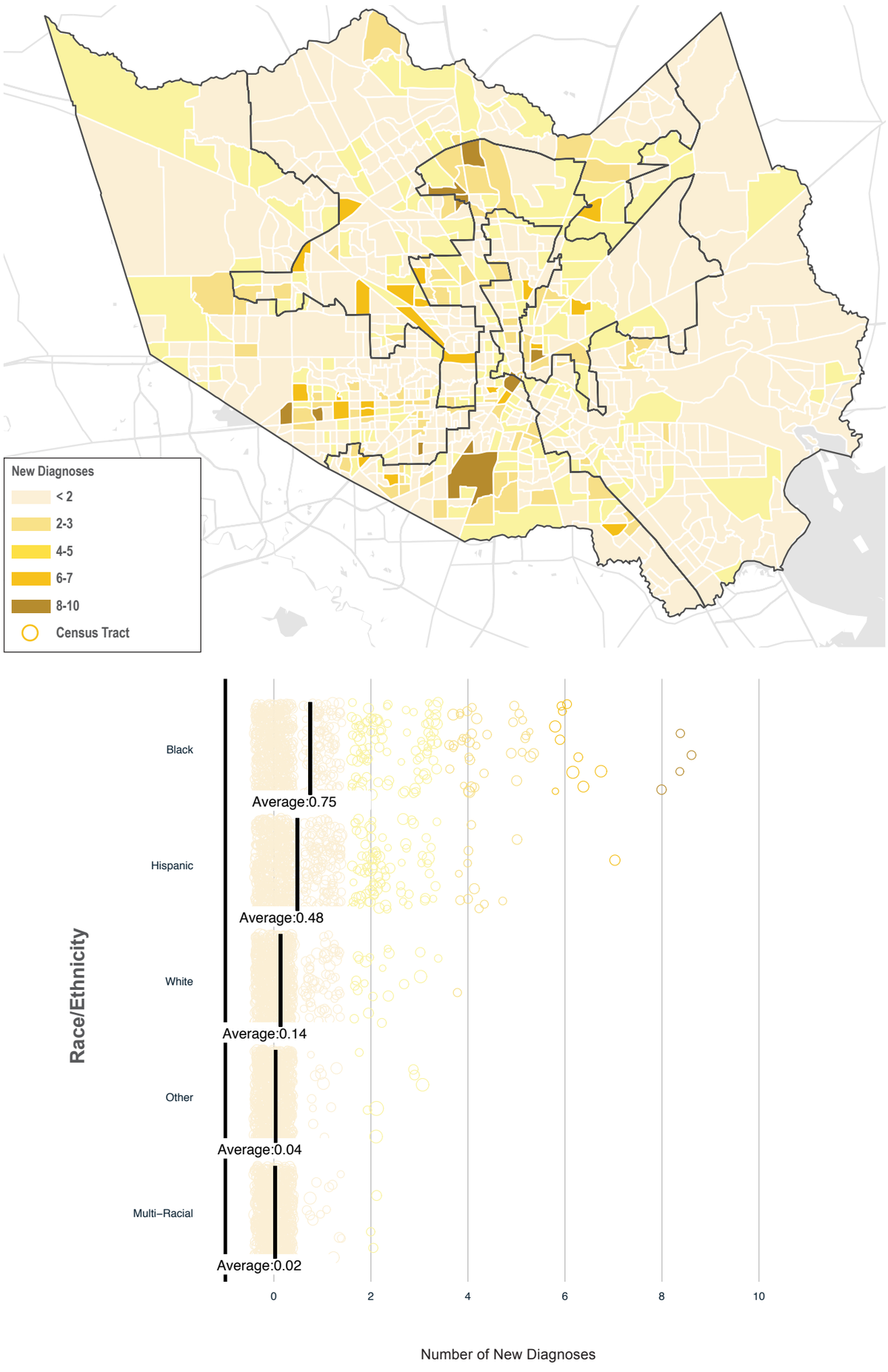


Figure 3.25 Number of New HIV Diagnoses by Race and Census Tract, Harris County, TX, 2017.
Source: TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services, 2017.



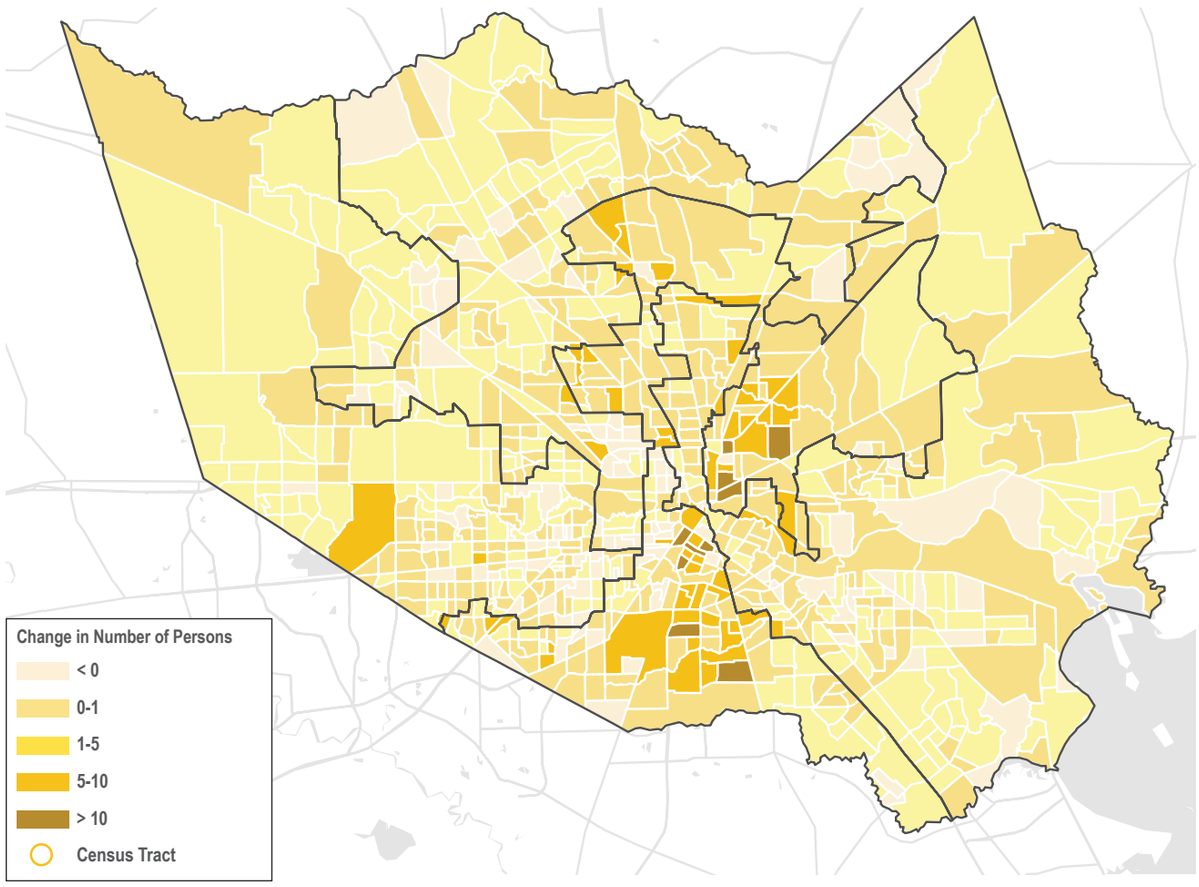
In Harris County, HIV cases remain highest among men who have sex with men (MSM), with Black MSM populations having the highest incidence, followed by Hispanic MSM populations. **Several social factors likely contribute to the higher incidence of HIV in communities of color including economic and educational inequalities, lack of access to health care, lack of culturally competent health care, and stigma.** With Harris County contributing 25% of all HIV cases reported annually in the State of Texas, Harris County faces many challenges in HIV prevention, diagnosis, and treatment.[654]

A particularly unique challenge is that Harris County is the only county of its size with two large local health departments providing varying services. HHD has been directly funded by CDC to conduct surveillance and prevention within the jurisdictions of both HHD and HCPH for HIV and sexually transmitted infections. Conversely, HCPH administers Harris County's Ryan White HIV/AIDS Program, which provides resources and treatment for individuals living with HIV who lack adequate health care coverage. This program also funds services that support access and retention of medical care for residents in surrounding counties, including Fort Bend, Chambers, Liberty, Montgomery, and Waller. In 2018, the Ryan White Part A program funded services for outpatient medical care, transportation, dental care, and health insurance premium assistance to 13,771 clients.[655]

Over the past few years, HCPH has worked with community partners, elected officials, and key public health stakeholders to develop a comprehensive HIV Prevention Program. The HCPH End HIV Task Force, comprised of multidisciplinary HCPH staff, was developed to improve HIV prevention and treatment in Harris County. Prevention services and resources provided by HCPH include testing, condom distribution, linkage to care, PrEP information, and awareness. While HCPH focuses on targeted testing strategies, all individuals who test positive are connected to care through HHD's HIV program. HHD offers mobile clinics as well as three traditional clinics that regularly offer HIV and STI testing. Access to detailed surveillance data for the entire community and information-sharing procedures and policies are needed to understand community needs and to evaluate program effectiveness. Furthermore, data access and proportionate funding to conduct HIV surveillance and epidemiological analysis within HCPH's jurisdiction would provide a more complete picture of community needs as well as prevention and services more efficiently and effectively.

In addition to HIV, other STIs are important to the health and well-being of Harris County residents. Not surprisingly, as the largest county in Texas, Harris County has the highest number of STI cases in the state of Texas and the trend in the number of cases is important to keep track of locally. For example, since 2013, cases of gonorrhea and syphilis have steadily increased each year. Cases of chlamydia also increased each year from 2013 to 2016 but declined in 2017 (Figure 3.27). Chlamydia is the STI with the highest burden, exceeding total counts of both gonorrhea and syphilis combined.[656] These increasing trends can also be seen on a national level with chlamydia, gonorrhea, and syphilis all having increased since 2014, reaching an all-time high in 2018.[657,658] STIs can not only have short-term, but also long-term impacts on health, especially if left untreated. Untreated STIs increase your chance of becoming infected with HIV or transmitting it if already infected. It can also cause long-term pelvic pain, infertility, and other complications.[659]

Figure 3.26 Change in Persons Living with HIV



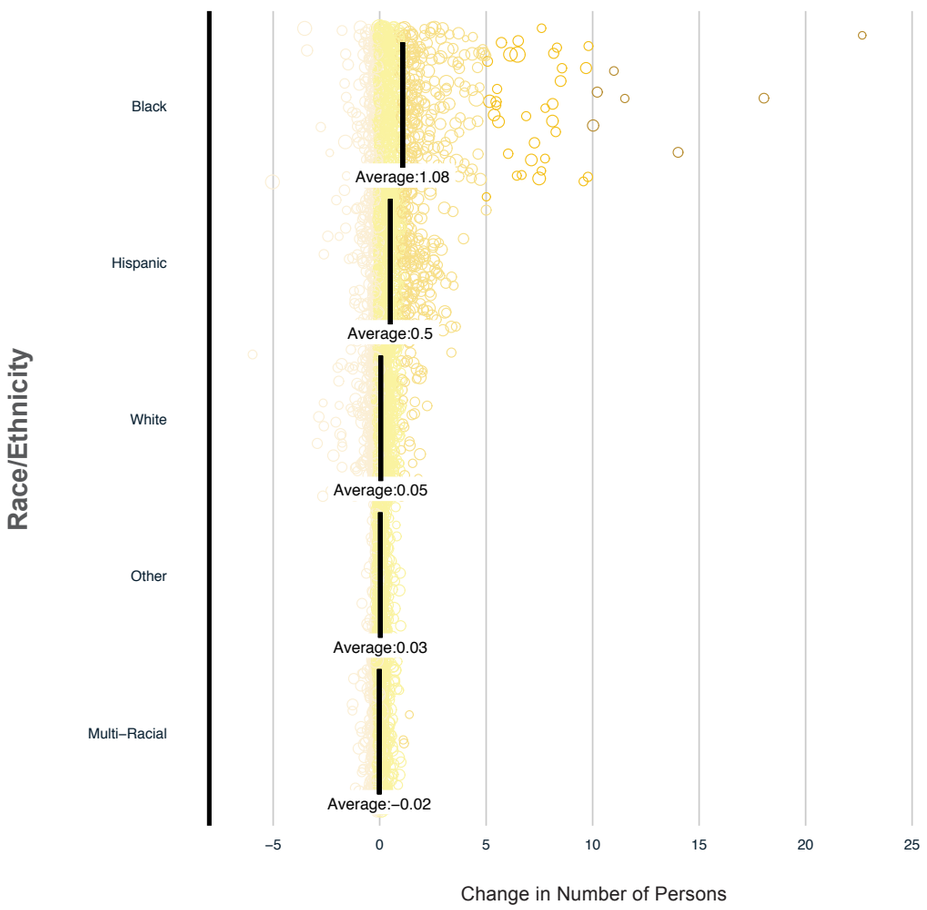


Figure 3.26 Change in Number of Persons Living with HIV per 1,000 People by Race and Census Tract, Harris County, TX, 2013 vs. 2017.
Source: TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services, 2013/2017.

Chlamydia is also the most reported bacterial STI on a national level. Although there were approximately 1.7 million cases reported across the United States in 2017, estimates of the true burden are expected to be much higher, as many people infected are asymptomatic, and never tested.[660] Typically, chlamydia is seen in younger populations, with almost two-thirds of new cases being found in persons between ages 15 and 24 years old. Blacks and Native Hawaiian or Pacific Islanders have the highest rates of chlamydia in Texas.

Gonorrhea similarly has a disproportionate impact on young people in the same age group. This STI is also underreported, with estimates of true burden being 820,000 people each year in this country. Nearly 70% fall into the young age category. Texas reflects the steadily increasing trends that are seen in Harris County.[661] Presently, 58% of all cases nationally and 64% of cases in Texas are seen among MSM populations.[662] Blacks are the minority most disproportionately affected by STIs, having the highest infection rates in Texas.

Given the continued concern for STI surveillance and treatment, as well as the number of partner agencies working together on the screening, referral, and treatment side, it is critical for public health agencies to work together. A strategy articulated previously is for HCPH and HHD to improve coordination on HIV and STI surveillance and prevention through the creation of shared-service workgroups. These workgroups have been suggested by previous reports, including Houston's 10-Year Plan Report,[663] Greater Houston Partnership's commissioned Lewin Group report, and others. Further, Rice University's Kinder Institute is also actively exploring the pros and cons of agency consolidation for the region, arguing such a consolidation may "reduce duplication and exercise a more effective use of finances and personnel."[664]



"Blacks are the minority most disproportionately affected by STIs"

Figure 3.27 Sexually Transmitted Infections

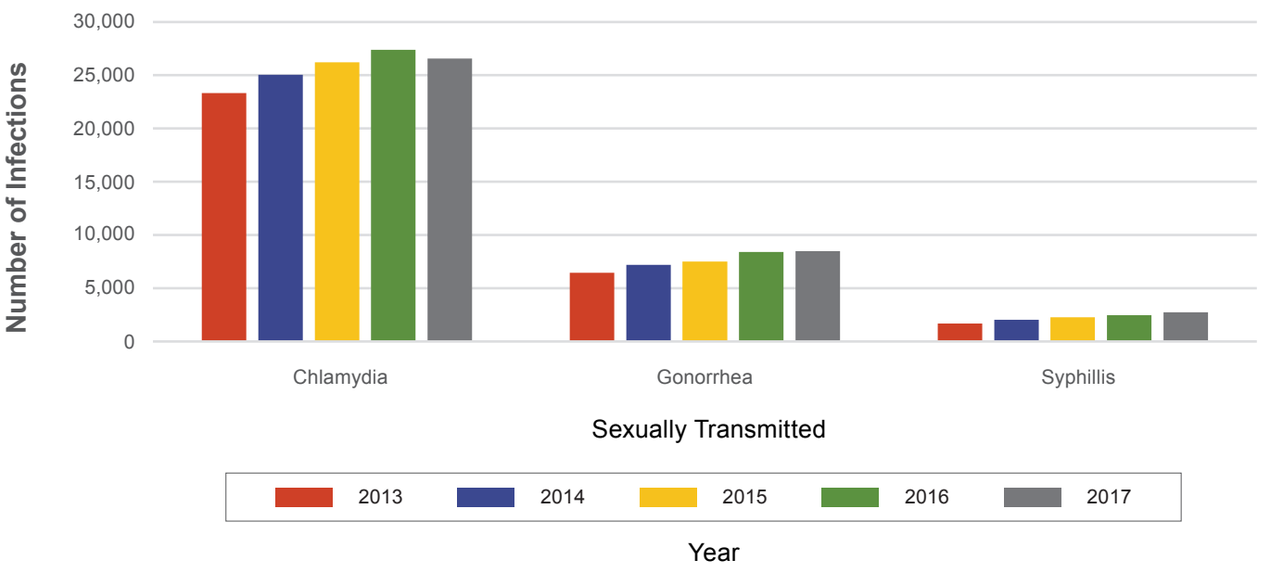


Figure 3.27 Number of Sexually Transmitted Infections, Harris County, TX, 2013-2017.
Source: TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services, 2013-2017.

A recent study modeling the potential impact of decreased vaccination rates found that a 5% decrease in vaccination rates could result in three times as many annual measles cases nationwide.[686] The same study estimated that each measles case costs $20,000 from the perspective of the public sector.[687]

Foodborne and Waterborne Illnesses

Foodborne and waterborne illnesses are caused by the consumption of contaminated foods and water. CDC estimates that each year roughly one in six Americans (or 48 million people) become ill, 128,000 are hospitalized, and 3,000 die of foodborne diseases alone.[665] The most common symptoms of these illnesses are nausea, vomiting, diarrhea, abdominal pain, fever, and chills. Oftentimes these illnesses are not caused by the most recent food or water consumed, but rather something consumed prior to that. This makes it difficult to ascertain the source of the symptoms.

Symptoms usually last for a short period of time, with individuals affected recovering on their own without treatment. Occasionally, these illnesses lead to more serious complications requiring hospitalization. While anyone can get a foodborne or waterborne illness, young children and older adults are particularly susceptible. Acute Hepatitis A virus (HAV) is one of the few examples of a foodborne illness that can be prevented by vaccination and is often recommended for certain travelers. Harris County has seen less than 22 acute HAV cases over the last five years. While many outbreaks of HAV are occurring throughout the country, as of October 2019, Harris County has not shown any outbreak activity to date. Although approximately 1,000 foodborne outbreaks are reported each year in the United States, most foodborne illnesses that occur are not part of recognized outbreaks – again, making them harder to detect even if causing significant symptoms and complications in an individual. In 2013, HHD detected a large shigellosis cluster of 175 cases in the region, which shared similar genetic markings, this spike can be seen in Figure 3.28.[666] A cyclosporiasis outbreak can also be noted on the graph in 2017.

Figure 3.28 Foodborne and Waterborne Cases

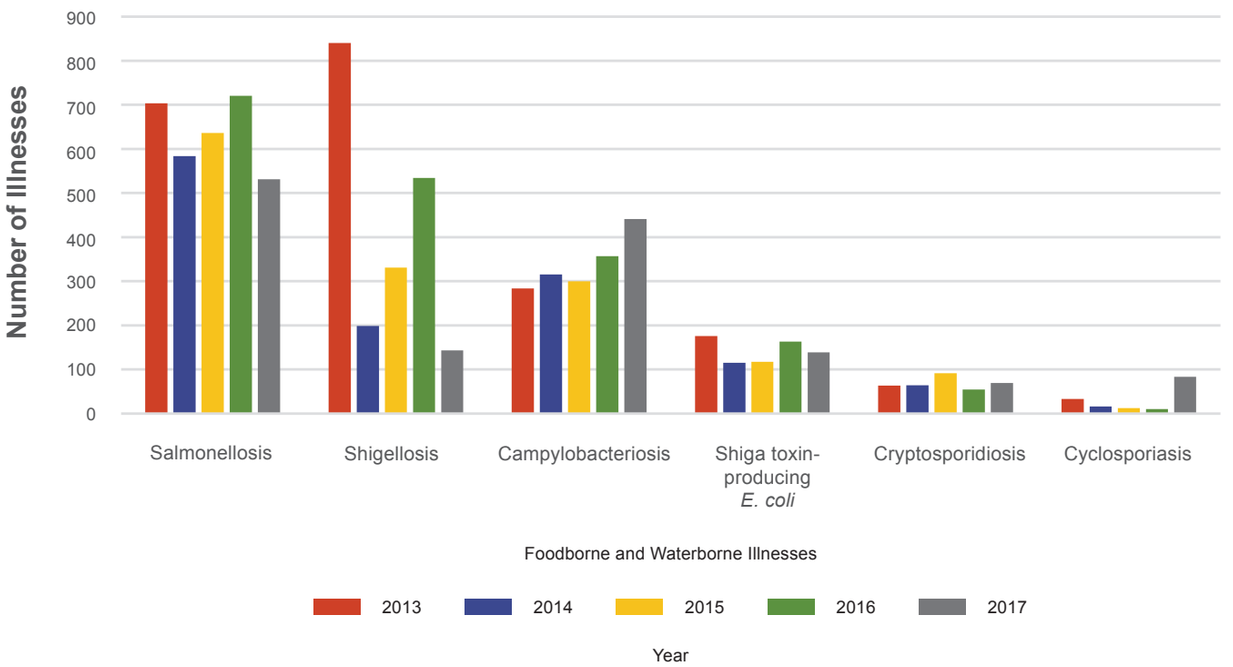


Figure 3.28 Number of Foodborne and Waterborne Illnesses, Harris County, TX, 2013-2017.
Source: Infectious Disease Control Unit, Texas Department of State Health Services, 2013-2017.

The role of environmental health programs is in part to safeguard the community from foodborne and waterborne illnesses. This is accomplished through routine and spontaneous inspections of restaurants, public pools and public wells, as well as educational efforts. For example, HCPH's Food Safety Summit (now in its fifth year), held annually for food establishment owners and managers, is an educational event focusing on safe food handling practices, foodborne illness prevention strategies, and avoiding common health and safety code violations. Providing this event at no cost to attendees has been an important step in getting food service employees the needed training on food handling methods that reduce the likelihood of foodborne illnesses.

A major limitation of HCPH's ability to prevent water and foodborne illness is Harris County government's inability to make ordinances. Structural reforms are explored in a recent Rice University Kinder Institute report, which argues that "counties that contain quickly growing metropolitan areas are increasingly expected to provide municipal-level services. However, counties are not situated with either revenue streams or ordinance powers to ensure they can provide this level of service. This reality limits what counties can do to encourage or shape development."[667] As such, Harris County cannot tailor its regulatory authority over restaurants and water wells to prevent the incidence of foodborne or waterborne illnesses.

In contrast, municipalities in Harris County including the City of Houston and the other 33 cities can pass ordinances, and can adapt their regulatory rules to the needs of its community. This creates a potential for differing health opportunities whereby residents of the unincorporated area of Harris County receive different protections from disease based on where they live. Although foodborne and waterborne illnesses may not present the same picture of disparity as other health inequities, barriers to an infection-

free Harris County still exist and are compounded by issues of jurisdiction and governance. Further exploration of opportunities between Harris County government and encompassed cities can enhance surveillance, investigation, and enforcement. This can also help alleviate potential confusion within the community about service delivery and potentially differing policies or rules.

MDROs, HAIs, and Sepsis

Multidrug-Resistant Organisms (MDROs) are pathogens that are resistant to more than one antibiotic and one of the biggest threats to global health, food security, and development.[668] Misuse of antibiotics in humans and animals has expedited the problem of growing resistance, making it more difficult to treat some infectious diseases, as treatments are becoming less effective.[669] MDROs are spread by direct contact between people, animals, or contaminated surfaces in the environment. MDROs are mainly found in health care facilities like: hospitals, skilled-nursing facilities, and long-term care facilities, with the risk of infection highest among older adults and immunosuppressed patients.

Some of the most challenging MDROs in health care facilities are Methicillin-resistant Staphylococcus aureus (MRSA), Carbapenem-resistant enterobacteriaceae (CRE), and multidrug-resistant acinetobacter (MDR-A). Antibiotic resistance causes infections in at least 2 million people and at least 23,000 deaths a year in the United States.[670] About 10% of hospitalizations are complicated by health care associated infections (HAIs) and as many as 75% of HAIs are caused by organisms that are first-line antimicrobial therapy resistant.[671] These resistant infections result in about $20 billion in annual health care costs nationwide.[672]

Reporting for CREs and MDR-A began in 2014, with 2015 being the first full year of reporting within Harris County. MDR-A cases have remained stable ranging from 203 to 227 annually over the three years since reporting began. CRE cases increased by about 100 cases from 2015 to 2016. However, case counts in 2015 and 2017 are comparable at around 366 cases (Figure 3.29).

Antibiotic resistance is a national security threat and significant global public health issue requiring cross-sector efforts to mitigate. In 2015, the *National Action Plan for Combating Antibiotic-Resistance*[673] identified a number of goals and strategies, including collaborative approaches for prevention (Case Example: *Antibiotic Resistance Prevention Collaborative*) and investment in national infrastructure to detect and respond to resistant infections. For example, CDC's Antibiotic Resistant Laboratory Network (ARLN) is a nationwide surveillance system that works to rapidly detect antibiotic resistance patterns and inform local agencies to intervene quickly, mitigating further spread of these pathogens. The ARLN was established in 2016 with the goals to detect, prevent, innovate and respond, with the hope of helping fight and slow antibiotic resistance.[674] From April 2018 through July 2019, the HHD Laboratory, the ARLN laboratory for the Houston-Harris County area, issued 217 alerts for the region. Of these alerts, 114 were residents of Harris County.

"In Harris County, S. pneumoniae (GBS) are the most common invasive strep infections."

Figure 3.29 MDRA and CRE Cases

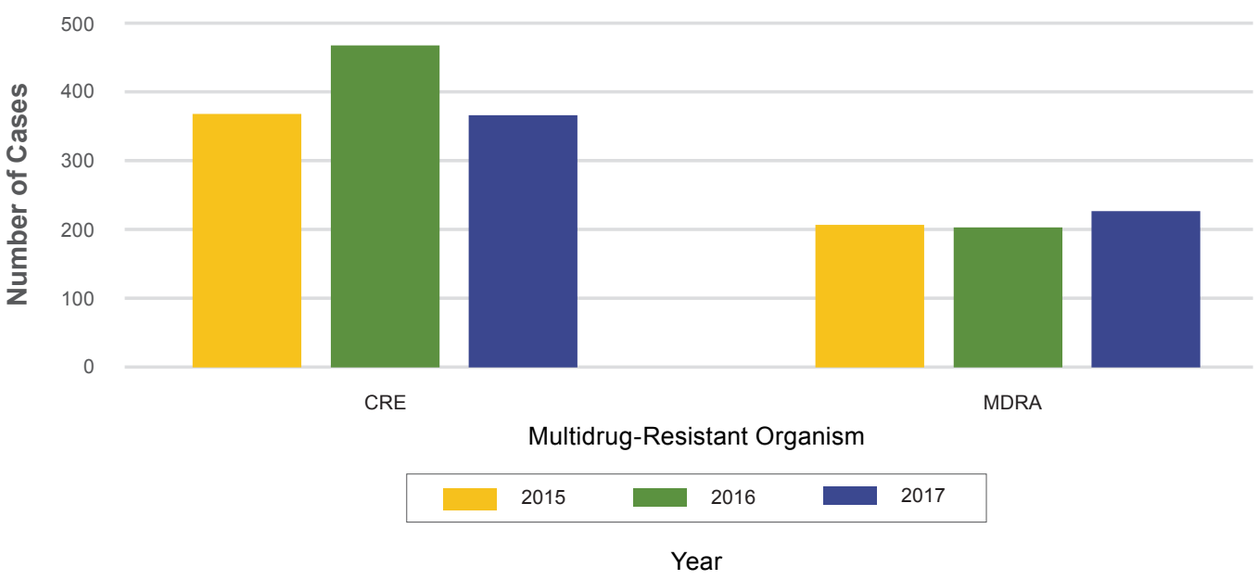


Figure 3.29 Number of Multidrug-Resistant Acinetobacter and Carbapenem-Resistant Enterobacteriaceae, Harris County, TX, 2015-2017.
Source: Infectious Disease Control Unit, Texas Department of State Health Services, 2015-2017.

Case Example: Coachella Valley's Antibiotic Resistance Prevention Collaborative

Addressing the global public health threat of antibiotic resistance requires multi-sector collaboration and action across health care, food industries, the environment, and our communities. The Coachella Valley Antibiotic Resistance Prevention Collaborative used an innovative approach leveraging health care district funds to join state and local public health with hospitals, local urgent care centers, skilled-nursing, and long-term facilities to coordinate infection prevention and control programs, strengthen regional surveillance efforts, and implement state and national action plans to address the threat of antibiotic resistance. The collaborative is led by the Eisenhower Medical Center and the California Department of Public Health's Healthcare-Associated Infections Program, with initial funding from the Desert Healthcare District. Expansion of this collaborative to engage other sectors, such as dentistry, is currently underway,.

Sepsis is the body's response to infection that can lead to tissue damage, organ failure and death. It results from the inability of the body to fight infection and can originate from an infection anywhere in the body. Though sepsis can impact any community member, older adults, pregnant women, infants, and those who are immunocompromised are more susceptible to sepsis.[675] There is a common misperception that sepsis only occurs in the hospital setting, yet patients will often present to a health care setting in sepsis from the community.

The burden of sepsis has been difficult to quantify since there is no one diagnostic test for sepsis, and it is not a notifiable condition. It is estimated that sepsis affects 1.7 million adults, contributing to 265,000 deaths in the United States each year. In fact, one of every three hospitalized patients in the U.S. die of sepsis. The global burden of sepsis is estimated at 30 million annually.[676] Sepsis remains a public health and health care challenge alike. While early detection of infection and immediate interventions are important in reducing the risk of sepsis, strategies should focus on reducing infectious disease exposure.

Reducing acquired infections through the following strategies are more likely to make a greater impact on reducing the burden of sepsis: getting the recommended vaccinations, better management of chronic conditions, reducing Hospital Acquired Infections (HAIs), and improving antimicrobial resistance stewardship.[677] Some studies have shown that recent antibiotic use increases the risk of sepsis. In combatting the condition, it is also important to create more integrated sepsis and infection prevention programs that span the continuum of inpatient and outpatient care, and involve partnerships among clinical professional organizations, patient advocacy groups, and public health organizations.[678]

Vaccine-Preventable Diseases

The development of vaccines to prevent certain infectious diseases has saved countless lives; these diseases are categorized as vaccine-preventable diseases. Examples include measles, mumps, and Hepatitis B. In Harris County, cases of Acute Hepatitis B remain stable with counts ranging between 20 and 39 annually. Cases of mumps were reported in 2013, 2016, and 2017, ranging from 6 to 13 cases. Two cases of mumps were reported in both 2013 and 2014 (Table 3.4). Due to people opting out of getting vaccinated, unfortunately preventable diseases have begun to see a rise nationwide. This has been particularly of concern of late with respect to measles, which has shown a resurgence in Harris County.

Prior to the introduction of vaccines, polio paralyzed tens of thousands of Americans each year, measles and varicella (chickenpox) infected hundreds of thousands, and mumps, rubella (German measles), and pertussis (whooping cough) infected tens of thousands of Americans.[679] Due to mandatory vaccination laws, polio is nearly eradicated worldwide, measles is no longer endemic to the United States, and all other vaccine-preventable diseases have drastically fewer cases than in pre-vaccine days.[680] Despite these advancements, approximately 42,000 adults and 300 children still die every year from vaccine-preventable diseases in the United States.[681]

Currently, Texas law requires that all children must be immunized against vaccine-preventable diseases. Children may be exempted for medical contraindications or, if their parents object, for reasons of conscience, including a religious belief.[682] Fifteen other states share similar exemptions, with the remaining 36 states having stricter laws for exemptions. Unfortunately, the percentage of incoming kindergarten students in Harris County schools with non-medical exemptions has gradually increased from 0.33% at the beginning of the 2010-2011 school year to 0.90% at the beginning of the 2018-2019 school year.[683]

While this is lower than the state-wide average of 1.20%, the upward trend of non-medical exemptions throughout Texas represents an increasing risk of preventable disease outbreaks. Data from the Texas Department of State Health Services (DSHS) shows that some school districts' kindergarten classes in Harris County are below the 95% vaccination coverage rate required for "herd immunity", the level of vaccine coverage needed to protect the community, and prevent such outbreaks.[684,685] Additional concerns related to the Texas Immunization Registry operating as an "opt in" system (rather than "opt out" system as in other states) further exacerbates vaccination related sharing of information among public health and healthcare entities alike. This can further the splintering between these two sectors working together against VPDs.

Harris County had four cases of measles at the start of 2019, after having only one case in 2018 and no cases from 2015-2017. If fewer people had been vaccinated, this could have turned into a much larger outbreak. For each case of measles identified this year by HCPH, an epidemiologist had to find and connect with 100 individuals that may have been the originally infected person to ensure the health and safety of the rest of the community. This underscores the importance of the quotidian work that public health engages in "behind the scenes" to protect the community. In addition to HCPH, many partners are involved in the fight against vaccine-preventable diseases such as the Immunization Partnership and Baylor College of Medicine's renowned immunization advocate Dr. Peter Hotez.



The HCPH Immunization Program provides immunizations to area residents either through its HCPH clinics or through outreach programs in the community. The HCPH Immunization Program provides immunizations to area residents either through its HCPH clinics or through outreach programs in the community. Over 500 providers in Harris County participate in the Texas Vaccines for Children (VFC) program, which is a federally funded program that provides vaccines at little-to-no cost to children who are uninsured, underinsured, or covered by Medicaid or CHIP.[688] HCPH's clinics also provide low-cost or free immunizations to children whose parents or guardians cannot afford to pay for the vaccination.

"The last time I was vaccinated was in high school and now I'm 29... I haven't had insurance for 10 years. I was too broke."

-Lauren C., Harris County Resident

Table 3.4 Vaccine-Preventable Disease Cases

Disease	2013	2014	2015	2016	2017
Hepatitis B, acute	29	33	39	24	20
Mumps	6	0	0	9	13
Measles	2	2	0	0	0

Table 3.4 Number of Vaccine-Preventable Disease Cases, Harris County, TX, 2013-2017.
Source: Infectious Disease Control Unit, Texas Department of State Health Services, 2013-2017.

Infectious Respiratory Disease

Infectious respiratory diseases are caused by viruses, bacteria, and other microorganisms. These viruses, bacteria, and other microorganisms can infect the respiratory system and spread through mucus and saliva. This usually occurs when an infected person coughs or sneezes.[689]

Group B streptococcus (GBS) is a common bacterium often carried in the intestines or lower genital tract. The bacterium is usually harmless in healthy adults. In newborns however, it can cause serious illness and lead to life-threatening complications, such as pneumonia, bacteremia, and meningitis. For women who are pregnant, CDC recommends a GBS screening between weeks 35 and 37 of pregnancy.[690] The number of invasive GBS cases reported in Texas has increased 345.5% over the past 10 years, ranging from 433 in 2007 to 1,929 in 2017 with 48% of the cases occurring in adults aged 60 years or more. However, the highest age-specific incidence rates of invasive GBS in Texas are seen in children less than one year of age (42.3 cases per 100,000 persons). Likewise, in Harris County, Group B cases have seen an upward trend, with 186 cases reported in 2013, and 263 cases in 2017 (Figure 3.30).

Figure 3.30 Invasive *Streptococcus* Cases

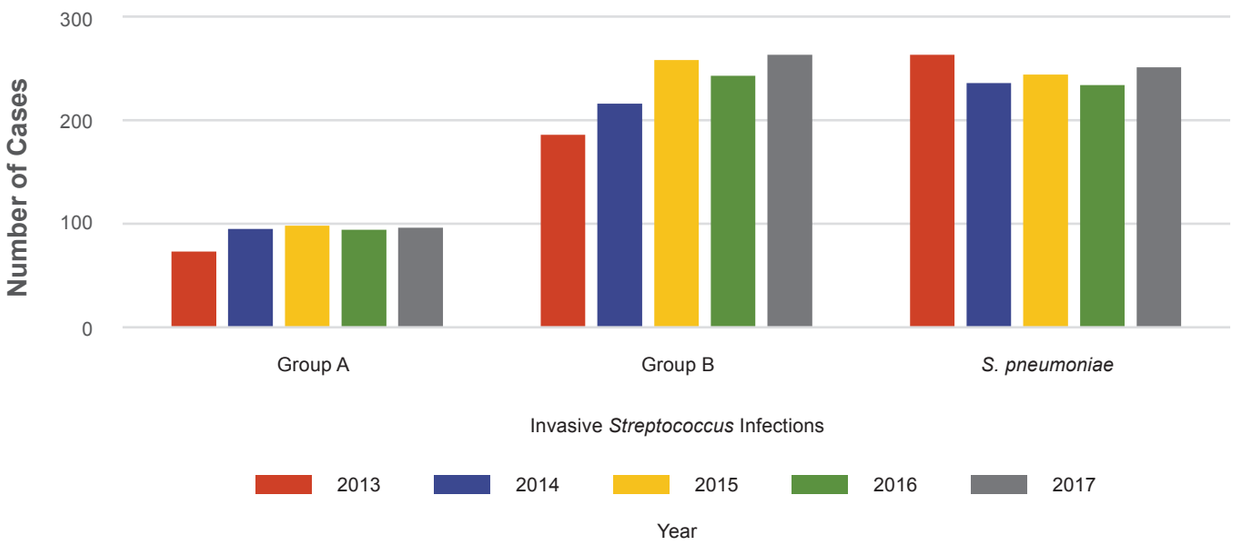


Figure 3.30 Number of Invasive Streptococcus Infections, Harris County, TX, 2013-2017.
Source: Infectious Disease Control Unit, Texas Department of State Health Services, 2013-2017.

S. *pneumoniae* is a vaccine-preventable bacteria which can be found in people's noses and throats and is spread from person to person through coughing, sneezing, or contact with respiratory secretions.[691] Groups at increased risk for invasive disease caused by S. *pneumoniae* are infants, older adults, and people with immunocompromised systems.[692] About 900,000 Americans get pneumococcal pneumonia each year.[693] In Texas, the incidence of S. *pneumoniae* invasive disease cases reported has been fairly stable from 2013-2017 with between 1,562-1,789 cases reported each year. In 2017, 131 deaths were reported, the majority of deaths occurring in adults age 50 and older. In Harris County, S. *pneumoniae* (GBS) are the most common invasive strep infections. The incidence rates of *S. pneumoniae* for Harris County are slightly below the rates for Texas.

Another serious type of pneumonia which is increasing according to Harris County surveillance reports is Legionnaires' disease or legionellosis, a lung infection caused by Legionella bacteria commonly found in water.[694] People can get sick when they breathe in mist or accidentally swallow water containing *Legionella* into their lungs. These bacteria are not transmitted from one person to another and are found naturally in the environment, usually in wet places like natural bodies of water, moist soil, and man-made water handling systems.

The bacteria grow best in warm water environments similar to what you would find in hot tubs, cooling towers, hot water tanks, large plumbing systems, and parts of the air-conditioning systems of large buildings.[695] *Legionella* outbreaks are commonly associated with hotels, resorts, long-term care facilities, hospitals, and cruise ships. The number of cases reported in the United States has been on the rise since 2000, with nearly 7,500 reports in 2017.[696] In Texas, the number of legionellosis cases reported ranged from a low of 168 to a high of 292 cases between 2013 and 2016.[697] Likewise, in Harris County, Legionellosis reports from 2013 to 2017 have ranged from 23 to 38 cases each year.

Influenza (flu) is another transmissible vaccine-preventable respiratory illness that can cause mild to severe illness and increase the risk of hospital admission and death among people with pre-existing chronic diseases.[698] Anyone can get the flu, but pregnant women, and children under five, and people 65 and older are most likely at risk for complications related to flu viruses. Complications of flu can include bacterial pneumonia, ear infections, sinus infections, and worsening of chronic medical conditions, such as congestive heart failure, asthma, or diabetes.[699] In fact, CDC estimates that influenza was associated with more than 48.8 million illnesses, more than 22.7 million medical visits, 959,000 hospitalizations, and 79,400 deaths during the 2017–2018 influenza season.[700]

Seasonal influenza illness is typically caused by influenza A virus subtypes H1N1 or H3N2, or by influenza B or C viruses. Influenza A and B viruses cause yearly epidemics—typically in the winter months. Consistent with how flu surveillance is done nationwide, Texas and Harris County monitor only influenza-associated pediatric mortality incidents which ranged between 7-23 deaths from 2013-2017. In 2017, 12 cases were reported for Texas, with 1 case in Harris County.[701] During the flu seasons, HCPH enhances flu surveillance and communication with community stakeholders by providing educational presentations to Independent School Districts at the beginning of flu season. Both HHD and HCPH produce weekly surveillance reports during flu seasons.

Close communication is maintained with area schools regarding levels of absenteeism due to influenza-like-illness, which school nurses report through a flu portal each day during the flu season. The best way to prevent the flu is by getting a flu vaccine each year, especially those attending childcare and long-term care facilities, as well as health care workers and emergency responders. The effectiveness of the flu vaccine varies year to year, ranging from 19% to 60% over the last decade, it has been shown that even during less effective seasons, getting the flu shot decreases the severity of the illness and risk of hospitalization compared with those who did not receive the vaccine.[702]

The flu vaccine is available from a variety of public and private sources such as public health departments, health care providers, pharmacies, etc. Nevertheless, access to care issues, misinformation, and the understanding of the need for getting annual flu vaccination can still drive individuals to avoid getting the flu shot which then adds additional costs to the (more downstream) health care system.

Vector-borne Diseases

Vector-borne diseases are caused by viruses, parasites, and bacteria transmitted by infected vectors such as mosquitoes, ticks, and fleas. The WHO states that 17% of the estimated global health burden for all infectious diseases can be attributed to those that are vector-borne.[703] CDC reports that cases of vector-borne diseases have more than tripled in the United States between 2004 and 2016.[704] Increasing temperatures and global travel and trade are the most significant factors influencing emergence in areas where they have not previously been found.[705] In addition, a number of factors affect human exposure to vectors and the diseases they transmit, including outdoor activity, personal protective behaviors such as repellent usage, and proximity to vector habitats.

Viruses transmitted by mosquitoes remain the focal point of vector-borne disease activity of public health importance in Harris County. The sub-tropical climate and geographic location of Harris County provides an optimal habitat for more than 50 mosquito species. Three species (*Culex quinquefasciatus, Aedes aegypti,* and *Aedes albopictus*) are of public health importance because they can spread West Nile virus (WNV), Saint Louis encephalitis (SLE), dengue, chikungunya, and Zika virus.

An outbreak of SLE in 1964 led Harris County voters to approve the creation of a Mosquito Control District in 1965 that paved the way for the HCPH Mosquito and Vector Control Division (MVCD) by way of a very successful integration in 1995. Despite how well-recognized the MVCD Program is nationally (and even globally), the per capita

Table 3.31 Positive Mosquito Pool Count

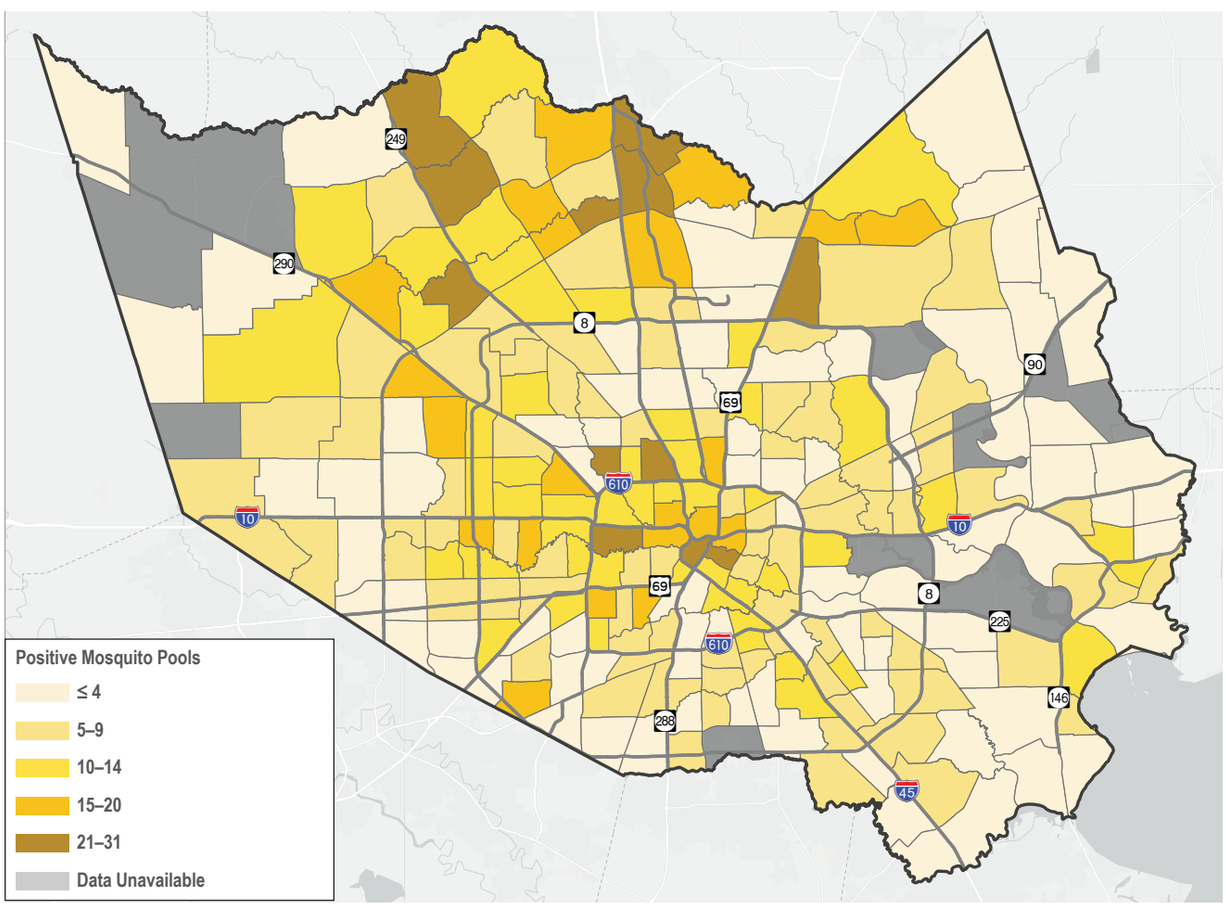


Figure 3.31 Positive Mosquito Pool Count by Mosquito Control Operational Area, Harris County, TX, 2013-2017.
Source: Mosquito Control Division, Harris County Public Health, 2013-2017.

spending on MVCD is less than $1 per Harris County resident, markedly less than what other highly regarded mosquito-control programs, like in Florida, allocate for their programs.

WNV is a vector-borne disease most commonly transmitted to people by the bite of infected mosquitoes. Since the identification of WNV in 2002 in Harris County, it has replaced SLE as the most prevalent vector-borne disease in Texas and has been detected annually in Harris County. Most people infected with WNV do not show any symptoms. One in five develop a fever and other symptoms, while 1 in 150 develop a more serious, sometimes fatal illness. Although anyone can become infected with WNV, older adults and persons with compromised or underdeveloped immune systems are at increased risk. Both WNV and SLE are endemic to Harris County.

The largest WNV outbreak to date in Harris County occurred in 2014 comprising of 134 human cases and causing two deaths. In addition, the highest counts of mosquito collections testing positive for WNV in a single season was reported that same year (Figure 3.31, Table 3.5).

Other vector-borne diseases transmitted by mosquitoes have emerged in Texas, which include chikungunya, dengue, and Zika virus. In Harris County, the first travel-related case of chikungunya was reported in 2014 and the first case of Zika virus was reported in 2015. Texas was the second state in the United States to report local transmission of Zika virus in 2016. MVCD's work highlights the oft-invisible nature of public health as many times the mosquito sprayers are doing their work in the middle of the night. To date, local transmission of chikungunya or Zika virus has not been reported in Harris County.

Globally, Zika virus has had a significant impact on local economies and health outcomes. Zika virus can be spread through several modes of transmission including the bite of an infected mosquito, from mother to child during pregnancy, and through sex with an infected person. Most people have very mild or no symptoms, and although rare, it may also cause Guillain-Barre syndrome. Currently, in terms of Zika virus infection, impacted populations include travelers to areas where Zika virus is circulating and immigrants moving from those areas.

Although dengue, an emerging vector-borne disease worldwide, has been reported as both travel-related and locally-transmitted in Harris County previously, no recent local transmission has been reported.[706]

Other Vector-borne Diseases

In addition to vector-borne diseases transmitted by mosquitoes, possible emerging and re-emerging tick-borne and flea-borne diseases are currently in the spotlight. Murine typhus, carried by fleas, is considered endemic and commonly occurring in southern Texas. However, over the last 10 years, new areas around the state including Harris County have seen increased activity. Currently, the highest numbers of flea-borne typhus reported in the United States annually are reported from Texas.[707] Case numbers in Harris County have increased annually since 2013.

While tick-borne diseases are on the rise nationally and in other parts of Texas; in Harris County the incidence of tick-borne disease remains low. Tick exposure can occur any time of the year, but ticks are most active during the warmer months (April-September).[708] Diseases commonly spread by ticks include Lyme disease, Rocky Mountain spotted fever (RMSF), Ehrlichiosis, and Powassan virus disease.

Vector-borne Disease Prevention

Prevention of vector-borne diseases transmitted by mosquitoes and other vectors begins at the community level. Resident-initiated control strategies such as "source reduction" of breeding sites (mosquitoes) and harborage sites (living areas for rats), use of personal protective measures together are the two most important methods to reduce human exposure. Taken together these preventive steps – again, more upstream in nature – can save tremendous amounts of dollars in the downstream health care system by preventing an individual from getting sick in the first place.

While community action is critical, an integrated vector management approach is needed to keep vector-borne disease incidence low.[709] HCPH practices this through a comprehensive vector management program that provides an understanding of the impact vector-borne diseases have on the community and guides the use of evidence-based control efforts. HCPH follows current best practices and continuously evaluates promising practices and novel products. Still, there are barriers and challenges in combating vector-borne diseases. While HCPH provides mosquito and vector control services to all of Harris County including the City of Houston, HHD conducts surveillance of these diseases within city boundaries. Robust and real-time data and information-sharing procedures and policies will improve understanding of the diseases in Harris County as a whole and further the notion of integrated surveillance and prevention.

Table 3.5 WNV Counts, Mosquito and Human

	2013	2014	2015	2016	2017
Positive Mosquito Pool Counts	148	1286	406	98	112
West Nile Human Cases	9	134	40	24	16

Table 3.5 West Nile Virus Counts, Mosquito and Human, Harris County, TX, 2013-2017.
Source: Infectious Disease Control Unit, Texas Department of State Health Services, 2013-2017; Mosquito Control Division, Harris County Public Health, 2013-2017.





Ebola Virus Disease Preparedness

Ebola virus disease (EVD) is a rare and deadly disease that mostly affects humans and other primates. EVD is transmitted to people from wild animals (such as fruit bats or non-human primates) and then spreads in the human population through direct contact with blood, secretions, or other bodily fluids of infected people. Symptoms of EVD include fever, severe headache, muscle pain, weakness, fatigue, diarrhea, vomiting, abdominal pain, and unexplained hemorrhage (bleeding or bruising). Symptoms may appear anywhere from two to 21 days after contact with the virus, with an average of eight to 10 days.[710] Many common illnesses can also present with the same symptoms, including flu or malaria.

Prevention measures include avoiding contact with blood and body fluids of an infected person, handling of infected cadavers, contact with bats and non-human primates or blood, fluids, and raw meat prepared from these animals (bushmeat).

The 2014–2016 outbreak in West Africa was the largest and most complex Ebola outbreak since the virus was first discovered in 1976.[711] In 2018, the Ministry of Health of the Democratic Republic of Congo (DRC) reported an outbreak of EVD. In June 2019, the Ugandan Ministry of Health confirmed their first imported case from DRC. No additional cases have been reported in Uganda since June 2019. However, the outbreak in DRC is ongoing with thousands of cases having been identified as of August 2019.[712]

To date, there has not been any EVD identified in Harris County. During the 2014 Ebola outbreak in West Africa, Dallas County had the first case of EVD that was diagnosed in the Americas and led to a cascade of public health and health care prevention and care steps to ensure other community members did not get infected with Ebola. At that time, local efforts in Harris County were stepped up and led to an incredible amount of community and health care provider concern about its spread given the relativity close proximity to Dallas. Additionally, Harris County being the home to significant international travel to/from Africa was also of concern.

Local public health officials designed preventive actions to ensure the safety of the community. For example, HCPH monitored 116 travelers arriving in Harris County from West African countries that had seen Ebola spread. Travelers were monitored for symptoms and fever checks daily for 21 days which is the incubation period for EVD.

Although EVD is a rare disease, given Harris County's diverse population, its industrial and community connections with other countries with EVD risk, and multiple international entry ports, preparedness for EVD was critical to protect Harris County residents and communities from potential threats, and requires a multifaceted and integrated approach. Not only did HCPH engage in these activities but so did other public health partners locally include HHD, Fort Bend, Montgomery, and Galveston Counties (as well as throughout Texas). Ebola (as well as Zika and a host of other diseases) highlight the important link between global health and domestic health. Communities such as Harris County – especially given their international connectedness – have a specific interest in working across borders to ensure the health and well-being of its residents.[713] This bidirectional relationship between global and domestic entities is key to success.



INFECTIOUS DISEASES

These recommendations, in no particular order, support the transformational recommendations offered in Transforming Health in Harris County and are created using existing data on health outcomes and evidence-based intervention.

Chapter 14 Recommendations

- Build Harris County capacity to identify and adapt best practices (One Health, telehealth, community health outreach, etc.) in global and domestic health, especially for disease surveillance and response.
- Advocate in the Texas State Legislature to allow large, urban counties to pass ordinances to protect better the community from infectious diseases.
- Support public awareness campaigns and other efforts that educate the public about the importance, safety, and effectiveness of vaccinations.
- Advocate in the Texas State Legislature for vaccination-related changes including the removal of non-medical exemptions, making participation in the Texas Immunization Registry "opt-out" (instead of "opt-in"), etc.
- Support investments in innovative service models and technologies such as Video Directly Observed Therapy, to advance cross-sector work to prevent and control infectious diseases (TB, Hepatitis, HIV, STIs, etc).
- Invest in efforts to increase screening of infectious diseases in Harris County, with a particular emphasis on those who are disproportionately impacted.
- Enhance epidemiology and other infectious disease response analytical capacity within public health agencies in Harris County.
- Support initiatives to provide widespread access to affordable vaccines for all residents, with a particular emphasis on those who are disproportionately impacted.
- Build strong and sustainable partnerships with community stakeholders and healthcare providers to spearhead immunization initiatives to improve vaccination rates.
- Increase support for the health care and public health systems to provide rapid linkage to care by identifying individuals who test positive for HIV and connecting them with partner organizations.
- Improve coordination among vector control service providers in Harris County, with a particular emphasis on enhancing information sharing necessary



“To better serve public health, there needs to be some formal coordination between public health departments within the region such as through a coordinating council…”

-Health System Stakeholder



Conclusion

Safe and effective vaccines, and the increasing availability of antibiotics have all helped to reduce the burden of infectious diseases. Overall the current infrastructure and partnerships help guard the Harris County community against emerging and known infectious diseases. Most infectious diseases present in Harris County are preventable and by increasing awareness and providing education to the community, supporting and strengthening public health infrastructure and surveillance, Harris County can attain the ultimate goal of preventing and reducing infectious diseases. However, this only can be achieved by collaboration, coordination, and communication, and aligned public health strategies.

Understanding infectious disease burdens in a community requires strong surveillance and robust epidemiological capacity. The epidemiological work done within Harris County is complicated by the blurred accountability that exists between muicipalities within Harris County. This in turn results in many reports being referred out to the different public health departments. This is especially common between HHD and HCPH, where a significant number (approximately 750 reports each year), for example, are referred out to HHD from HCPH. Each of these reports must first be captured, meaning superfluous time is spent on data entry. A potential benefit of program or service integration would be to eliminate these types of administrative inefficiences. Such integration would also help bring about equity to epidemiological capacity for the region, which is recommended to have the ratio of one epidemiologist for every 100,000 residents. [714] Such epidemiologic capacity is not equitably shared across the county.

“ ... it is recommended to have the ratio of one epidemiologist for every 100,000 residents.”

Conclusion

"Houston has the greatest medical complex in the world, but it also has the highest percentage of children without health insurance of any major American city. With Harris County at the forefront of the demographic transformations that are occurring across the country, public health professionals are challenged as never before to ensure access to quality health care in the face of deepening socioeconomic and cultural divides.

Their success in meeting those challenges will have profound implications for public health outcomes not only in Harris County but across America."

– Stephen L. Klineberg, Founding Director, Kinder Institute for Urban Research, Professor Emeritus of Sociology, Rice University

A 'healthy community' is a state of mind long before it becomes a matter of fact. It requires bringing together key elements such as community engagement, necessary data, innovative practices, and the belief that good health within a community benefits everyone. A healthy community assures resilient, enabled residents. It supports a sustainable infrastructure. And it requires leadership, vision, resolve, and resources.

Improving health in a community as large, complex, and diverse as Harris County is a multi-step process that involves analysis, planning, and execution. This study is the first step – analysis. Within it, the authors explore several health issues such as infectious disease, chronic disease, mental health, substance abuse, and more. They delve into each issue from several different perspectives, including the role of public health and prevention; health care access and coordination; the impact of health care financing; and the role of social determinants of health, as crucial drivers for achieving health equity.

In the course of authoring this study, one thing became abundantly clear: policy makers at the national and state levels have often failed this community – and many similar communities across the nation – with respect to health. While the ACA has shown some improvements in health outcomes, it has failed to deliver on its promise to bend the cost curve. Worse yet, Texas, by refusing Medicaid expansion, has decided to deny needed health coverage to over a million of its residents and yet those dollars have gone to help support the health of other residents in other states. The responsibility and mandate to build a healthy Harris County now rests largely with locals.

This study is an exploration of where Harris County is on its journey to becoming a healthy community and identifies what the next steps could be. This study set out to answer many questions including: Where does Harris County stand currently with respect to health? What does a healthy community look like? What would the health care and public health systems look like in such a community? And how can Harris County get there?

Transforming Health in Harris County requires a simple but necessary understanding that health is so much more than health care delivery, and that all institutions involved in health must increase their strategic alignment as well as improve communication, coordination, and collaborations for the betterment of the health of this community. There is a growing recognition that health care and public health are natural partners that complement each other.

This recognition, however, has not fully trickled down to the local level, as many silos continue to exist in the system. Some would argue that it is not truly a system at all but rather a set of independent entities working in their own silos coming together at times but largely motivated by their own missions. As such, systems-level change is needed to ensure health care access, especially with a focus on prevention, is available to all. Change will only occur when barriers to availability, acceptability, and affordability as stipulated in this study are removed.

Removing these barriers requires upfront investment. Current downstream costs can be viewed as future upstream opportunities; this study has presented the business case that public health and prevention programs can produce savings in the long-run. Ex-

isting case studies in mental health and well-being, dialysis, and smoking cessation, to name a few, have shown that public health efforts and prevention programs truly can pay for themselves. The alternative – or rather, the current system – is to have a fragmented system with wrong pocket investments. A disease care system that awaits when one gets sick or injured and then repairs as best it can.

Building Resilience in Harris County requires a commitment to health equity to ensure that all residents have the full opportunity to flourish without avoidable impediments to health. Health equity in Harris County is not fully realized, yet there is a growing recognition and impetus to address these very inequities. Both individual and community resilience are crucial in times of emergency, but helping support resilience begins well before a disaster ever strikes. Tools such as CASPER and the Hurricane Harvey Registry help Harris County better understand and measure community needs and resiliency, which are critical to helping health care and public health work together to enact the appropriate steps to advance resiliency.

The environment shapes resiliency through its impact on health and this occurs where one lives, learns, works, worships, and plays. Clean air and drinking water, for example, are essential to a healthy community, yet not all Harris County residents are afforded this basic necessity. While there are important steps to be taken to redress areas with poorer quality or worse health outcomes, true resiliency will only be built when health is taken into consideration at the policy level and prior to the onset of activities that can later impact health. Tools such as Health Impact Assessments can, from the onset, help towards mitigation and promote cross-sector collaboration.

The built environment and the way in which communities are designed play a crucial role in health and resiliency as well. Children thrive when they have safe routes to schools, easy access to parks, and many options for nutritious food. The built environment and optimal community design can improve safety through pedestrian-activated traffic signals, wide side walks, and animal control methods. Affordable and safe housing is a critical issue for working-class families.

Community resilience also requires optimal mental health and well-being for individuals. Harris County, like much of the rest of the nation, has inadequate mental health resources. The current system is woefully underfunded at the federal and state levels and, unless this is addressed, will unfortunately require additional planning and investment at the local level. These investments should aim to improve social and other factors in well-being, such as economic empowerment, to have the widest impact.

A Snapshot of Health in Harris County provides insight into the chronic diseases, infectious diseases, injuries, and family health that impact Harris County residents. Like elsewhere, chronic diseases are the leading causes of death in Harris County. Yet public health surveillance, prevention, and treatment of chronic diseases lag behind infectious diseases, as an example. Several opportunities exist to improve the prevention of diabetes and obesity, both of which are widespread in the community. Yet, all of these opportunities require commitment to health.

Injuries – whether intentional or unintentional – also clearly affect Harris County residents, though innovative interventions could reduce their prevalence. Death or harm from all forms of violence including suicide and homicide are substantial threats to community well-being. Fatal gun violence, for example, also affects the health and well-being of communities through their impact on witnesses and family members, especially children.

As a whole, Texas would benefit from increased investment in programs to improve what authors here refer to as family health. The whole of the family, including maternal and child health outcomes as well as the role of men as part of the family unit, must be kept in mind in health investment and planning. Harris County has several opportunities for improvement in this regard through smart and innovative approaches that prevent poor results.

The infectious diseases that threaten the community, like MDROs, sepsis, TB, and STIs, including HIV/AIDS, require more than a vaccine or an antibiotic. Though vaccines are one of the most powerful tools that public health practitioners have available to protect their communities, addressing these diseases equally requires multiple agencies and programs to work harmoniously together to ensure robust disease surveillance, prevention, and treatment activities.

The five *Transformational Recommendations* are, at their essence, an answer to the questions above. A healthy community is one where all residents have access to primary care (T. Rec #3), and the health care and public health systems have the necessary infrastructure, including innovative systems such as telehealth and mobile units, to respond to all the community's needs (T. Rec #2). Harris County can get there by embracing a culture of health that invests in upstream or prevention strategies (T. Rec #1) and by driving alignment of strategy among health-related organizations (T. Rec #4) and consolidating wasteful overlap where feasible (T. Rec #5). Taken together, these "T. Recs" allow Harris County to move forward swiftly, methodically, and with purpose to improve on health and well-being not just for today but for tomorrow.

However, the answers to these questions, in the form of the five *Transformational Recommendations*, are just a roadmap for a vision for health in the decade to come. The journey is long and will take many twists and turns. *Harris Cares* is the beginning of that journey and though it will not answer every question it furthers the notion that Harris County is interested in the health and well-being of all of its residents and is willing to invest as such.

For this study to be truly impactful, it requires careful examination of the recommendations and thoughtful planning on how to execute them. And for this all to be successful, it will require community-wide initiative and activity – not just within Harris County government but well beyond it. The very future of the health and well-being of this incredibly strong community is dependent upon it.

Appendices

Acronyms and Abbreviations

AIDS	*Acquired Immunodeficiency Syndrome*
ATSDR	*Agency for Toxic Substances and Disease Registry*
ACOG	*American College of Obstetrics and Gynecology*
ARC	*American Red Cross*
ADA	*Americans with Disabilities Act*
BARHII	*Bay Area Regional Health Inequities Initiative*
CRE	*Carbapenem-Resistant Enterobacteriaceae*
CMOC	*Catastrophic Medical Operations Center*
CDC	*Centers for Disease Control and Prevention*
CMS	*Centers for Medicare and Medicaid Services*
CBD	*Central Business District*
CPS	*Child Protective Services*
CHIP	*Children's Health Insurance Program*
COPD	*Chronic Obstructive Pulmonary Disease*
CASPER	*Community Assessment for Public Health Emergency Response*
CHNA	*Community Health Needs Assessment*
CRO	*Community Resilience Officer*
CATCH	*Coordinated Approach to Child Health*
DDT	*Dichlorodiphenyltrichloroethane*
DOT	*Directly Observed Therapy*
ED	*Emergency Department*
EMS	*Emergency Medical Services*
ETHAN	*Emergency Telehealth and Navigation*
ESRD	*End-Stage Renal Disease*
EPA	*Environmental Protection Agency*
FHWA	*Federal Highway Safety Administration*
FQHC	*Federally Qualified Health Center*
FTE	*Full-time equivalent*
FNSS	*Functional Needs Support Services*
GRB	*George R. Brown Convention Center*
GI	*Green Infrastructure*
GDP	*Gross Domestic Product*
GBS	*Group B Streptococcus*
HCFC	*Harris County Flood Control*
HCMS	*Harris County Medical Society*
HCOHSEM	*Harris County Office of Homeland Security and Emergency Management*
HCPCS	*Harris County Pollution Control Services*
HCPH	*Harris County Public Health*
HCSO	*Harris County Sheriff's Office*
HIA	*Health Impact Assessments*
HIR	*Health Impact Reviews*
HIT	*Health Impact Team*
HiAP	*Health in All Policies*
HPSA	*Health Professional Shortage Area*
HRSA	*Health Resources and Services Administration*
HARC	*Houston Advanced Research Center*
HFD	*Houston Fire Department*
HFB	*Houston Food Bank*
HHD	*Houston Health Department*
HIV	*Human Immunodeficiency Virus*
HPV	*Human Papillomavirus*
IMPACT	*Improving Public Health Management for Action*
IMR	*Infant Mortality Rate*
ISH	*Institute for Spirituality and Health*
IDD	*Intellectual and Developmental Disabilities*
ITC	*Intercontinental Terminals Co.*
LGBTQ	*Lesbian, Gay, Bisexual, Transgender, and Queer*
LBW	*Low Birthweight*
MSM	*Men who have Sex with Men*
MICU	*Mobile Intensive Care Unit*
MDR-A	*Multi-Drug Resistant Acinetobacter*
MDRO	*Multidrug-Resistant Organisms*
NATA	*National Air Toxics Assessment*
NACCHO	*National Association of County and City Health Officials*
PAH	*Polycyclic Aromatic Hydrocarbons*
PCB	*Polychlorinated Biphenyl*
PM	*Particulate Matter*
RHPC	*Regional Healthcare Preparedness Coalition*
ROI	*Return on Investment*
STI	*Sexually Transmitted Infection*
SETRAC	*Southeast Texas Regional Advisory Council*
SAMHSA	*Substance Abuse and Mental Health Services Administration*
TCEQ	*Texas Commission on Environmental Quality*
TTHM	*Trihalomethane*
TB	*Tuberculosis*
US	*United States*
HUD	*U.S. Department of Housing and Urban Development*
VDOT	*Video Directly Observed Therapy*
VOCs	*Volatile Organic Compounds*
WIC	*Women, Infants, and Children*
WHO	*World Health Organization*

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Centers for Disease Control and Prevention, National Center for Health Statistics. (2010-2015). *US Small-area Life Expectancy Estimates Project (USALEEP)* [Data file]. Retrieved from https://www.cdc.gov/nchs/nvss/usaleep/usaleep.html#data

US Small-area Life Expectancy Estimates Project (USALEEP) estimated life expectancy at birth for the period 2010-2015, by census tract. Death records of US residents (excluding residents of Maine and Wisconsin) for deaths in 2010 to 2015 were geocoded based on descendants' residential addresses. Statistical modeling based on population estimates (2016 American Community Survey (ACS) 5-Year Estimates, US Census Bureau) is used to address issues associated with small population sizes and missing age-specific death counts.

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City of Houston, Houston Health Department. (2019). *COHGIS open data portal* [Facility locations]. Retrieved from https://cohgis-mycity.opendata.arcgis.com/datasets/coh-health-department-facilities

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Esri Demographics. (2018). *2018 total population* [Spatial data]. Retrieved from https://doc.arcgis.com/en/esri-demographics/data/census-acs.htm

2018 total population is estimated based on US Census 2010 geographies. Note that population density is calculated by normalizing total population by area in square miles.

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Greater Harris County 9-1-1 Emergency Network. (2019). *Harris County emergency network* [Web service]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/Emer_Response/EMS_FS/MapServer

- Figure 1.35 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.

Harris County Public Health. (2019). *Harris County Public Health facilities* [Facility location]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/HCPHES/HCPH_Locations_FS/MapServer/0

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Harris County Public Health, Office of Public Health Preparedness and Response. (2019). *2017 EMS calls* [Survey data]. Houston, TX: Harris County Public Health.

The Office of Public Health Preparedness and Response conducted interviews in person and by phone to obtain the call volume at each EMS agency within Harris County for the period during Hurricane Harvey (8/26/2017 - 8/31/2017) and for the entire year of 2017. Using this survey data, we map the number of calls in 2017 per 1,000 people for each EMS service area. On the same map, we also indicate the population for each EMS service area.

- Figure 1.35 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.

Harris County Public Health. (2019). *Health studies community health survey* [Survey data]. Houston, TX: Harris County Public Health.

Harris County Public Health stakeholders in leadership roles of academia, health systems, philanthropy and economic development, social services and community development, and state/national associations were contacted to participate in a survey on the strengths and challenges of addressing the health issues of Harris County and what the roles of a local public health department should be. From a pool of 185 unique stakeholders, a total of 125 phone survey responses from 108 unique organizations were collected.

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Harris Health System. (2019). *Harris Health System locations* [Facility locations]. Retrieved from https://www.harrishealth.org/locations/hhs

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Health Resources & Services Administration. (2019). *Health center service delivery and look-alike sites* [Data file]. Retrieved from https://data.hrsa.gov/data/download

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Health Resources & Services Administration. *Shortage designation* [Map services]. Retrieved from https://data.hrsa.gov/maps/services

Data from the Health Resources & Services Administration was used to visualize areas designated as medically underserved areas/populations and primary care health professional shortage areas throughout Harris County. Medically underserved areas are a type of federal designation for a geographic area that weighs various measures for having too few primary care providers, high infant mortality, high poverty, and/or a high percentage of older citizens. Medically underserved populations focus not on a geographic area but on certain underserved sub-populations. Primary care health professional shortage areas are areas designated as health professional shortage areas due to not meeting a threshold population to provider ratio for primary care.

- Figure 1.21 Medically Underserved Areas/ Populations and Primary Care Health Professional Shortage Areas (HPSAs), Harris County, TX.

NeedyMeds. (2019). *Free/Low-Cost/Sliding scale clinics* [Data file]. Retrieved from https://www.needymeds.org/licensing

The data on low cost and sliding scale clinics is from NeedyMeds, a non-profit information resource for people who need help with the costs associated with health care. Specifically, clinics that provide medical/dental care at no or reduced cost for individuals who meet specific financial guidelines are included in this database.

- Table 1.7 Hours of Operation for Low Cost and Sliding Scale Clinics, Harris County, TX, 2019.
- Table 1.8 Languages Offered in Low Cost and Sliding Scale Clinics, Harris County, TX, 2019.

Organization for Economic Co-operation and Development Health Statistics. (n.d.). *Life expectancy at birth* [Data file]. Retrieved from https://data.oecd.org/healthstat/life-expectancy-at-birth.htm

Life expectancy at birth, defined as the average age a newborn can expect to live if current death rates hold constant, is provided by OECD Health Statistics. We look at life expectancy for 13 comparable industrialized countries as determined by the Kaiser Family Foundation.

- Table 1.1 Life Expectancy for Comparable Industrialized Countries, 2013-2017.

Robert Wood Johnson Foundation. (n.d.). *Could where you live influence how long you live?* [Web application]. Retrieved from https://www.rwjf.org/lifeexpectancy

This web application is based on the US Small-area Life Expectancy Estimates Project (USALEEP) which estimates life expectancy at birth for 2010-2015, by census tract.

- Table 1.2 Life Expectancy for Harris County, Texas, and the United States, 2010-2015.

Texas Department of State Health Services, Center for Health Statistics. (2016-2018). *Texas hospital emergency department Public Use Data File (PUDF)* [Data file]. Retrieved from https://www.dshs.texas.gov/thcic/OutpatientFacilities/Texas-Emergency-Department-Data/

Emergency department hospital visits is based on inpatient and outpatient data from the Texas Department of State Health Services. The data includes visits to hospitals and ambulatory surgical centers in which a patient received services that included an invasive surgical procedure or an imaging/radiological procedure, as well as all hospital emergency department visits. The data was filtered to only include Harris County residents, regardless of which reporting facilities they went to. Note that end-stage renal disease visits were based on emergency department visits in which patients received a principal diagnosis of end-stage renal disease.

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Texas Department of State Health Services, Center for Health Statistics. (2017). *Texas hospital inpatient discharge Public Use Data File (PUDF) & Texas outpatient surgical and radiological procedure Public Use Data File (PUDF)* [Data files]. Retrieved from https://www.dshs.state.tx.us/thcic/hospitals/Inpatientpudf.shtm

Inpatient hospital visit data is at the patient-level, for patients who were admitted into the hospital for care. Outpatient hospital visit data is at the patient-level, for outpatient

services that do not go more than 24 hours from the time they are being treated in the hospital or ambulatory surgery center. The data was filtered to only include Harris County residents who went to a reporting facility with a Harris County zip code. This data was used to determine the number of inpatient and outpatient cases and their total charges of preventable hospitalizations, as defined by the Agency for Healthcare Research and Quality categories from 2017. Total charges included a sum of accommodation charges, non-covered accommodation charges, ancillary charges, and non-covered ancillary charges. Note that the rate of preventable hospitalizations was calculated by dividing the number of preventable hospitalizations by the total number of hospital visits for adults aged 18 or older.

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Texas Department of State Health Services, Health and Human Services Commission. (2018/2019). *DSHS licensed facilities* [Facility location]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/HCPHES/DSHS_Licensed_Facilities_FS/FeatureServer

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Texas Education Agency. (2017-2018). *Reports and data* [Data file]. Retrieved from https://tea.texas.gov/Reports_and_Data

- Figure 1.28 Number of Students per Mental Health staff by Independent School District, Harris County, TX, 2017-2018.

Texas Medical Board. (2019). *Licensed physician database* [Data file]. Retrieved from http://orssp.tmb.state.tx.us/

- Table 1.3 All Texas Medical Board Licensed Physicians, Harris County, TX, 2019.
- Figure 1.26 Selected Specialty Physicians That Accept Medicare/Medicaid and the Percentage of Adults Who Delayed Getting Specialist Care by PUMA, Harris County, TX, 2018.

The Harris Center for Mental Health and IDD. (2019). *Our locations* [Facility location]. Retrieved from https://www.theharriscenter.org/About/Contact/Our-Locations

- Figure 1.23 Areas Within a Two Mile Radius to Local Government Health Facilities, Harris County, TX, 2019.

The University of Texas School of Public Health. (2018). *Health of Houston 2018* [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/

The Health of Houston Survey 2018 is based on telephone interviews that were conducted between June 2017 and May 2018. 5,700 adult respondents were randomly selected in each sub-county geographical stratum in Harris County. Survey responses are weighted to obtain a representative sample of Harris County residents across aggregations of PUMAs and other sociodemographic characteristics.

- Figure 1.26 Selected Specialty Physicians That Accept Medicare/Medicaid and the Percentage of Adults Who Delayed Getting Specialist Care by PUMA, Harris County, TX, 2018.
- Figure 1.40 Percentage of Adults Who Delayed Seeing Doctor by PUMA, Harris County, TX, 2018.
- Figure 1.55 Percentage of Adults Who Smoke Cigarettes At Least Some Days by PUMA, Harris County, TX, 2018.
- Figure 1.56 Percentage of Adults Who Had 14 or More Days with Poor Mental Health in the Past 30 Days by PUMA, Harris County, TX, 2018.
- Figure 1.57 Percentage of Children Without Insurance by PUMA, Harris County, TX, 2018.
- Figure 1.58 Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines by PUMA, Harris County, TX, 2018.
- Figure 1.59 Percentage of Adults Who Are Classified as Obese by PUMA, Harris County, TX, 2018.
- Figure 1.60 Percentage of Adults with Diabetes by PUMA, Harris County, TX, 2018.

US Census Bureau. (2010). *Public Use Microdata Areas (PUMAs)* [Data file]. Retrieved from https://www.census.gov/programs-surveys/geography/guidance/geo-areas/pumas.html

Public Use Microdata Areas (PUMAs) are aggregations of census tracts into sub-county regions. For instances in which more granular geographic data is not available, we use data at the PUMA level.

- Figure 1.2 Public Use Microdata Areas (PUMAs), Harris County, TX.

US Census Bureau. *American Community Survey (ACS)* [Data file]. Retrieved from https://factfinder.census.gov/

- Figure 1.6 Demographic Changes in Harris County by Decade (1980-2010) and ACS Estimates (2017).
- Figure 1.22 Selected Local Health Facilities and the Percentage of Adults Without Health Insurance by Census Tract, Harris County, TX, 2016.
- Figure 1.30 Hospital Locations and Five-Year Population Change by Census Tract, Harris County, TX, 2013 vs. 2017.
- Table 1.9 Uninsured Population, Harris County,

TX, 2013-2017.
- Figure 1.36 Percentage of Adults That Were Insured and Uninsured, Three Largest US Counties, 2017.
- Figure 1.37 Percentage of People Without Health Insurance by Socio-Demographic Group, Harris County, TX, 2017.
- Figure 1.38 Percentage of People Without Health Insurance by Census Tract, Harris County, TX, 2017.
- Figure 1.39 Percentage of Adults That Had Private Insurance, Public Insurance, or No Insurance, Harris County, TX, 2017.

US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. (2016). *CDC's Social Vulnerability Index* [Index]. Retrieved from https://svi.cdc.gov/data-and-tools-download.html

The CDC's Social Vulnerability Index uses the 2016 American Community Survey 5-Year Estimates by the US Census Bureau, to determine social vulnerability at the census tract level. The index ranks each census tract on 15 social factors, which are grouped into four themes: Socioeconomic Status, Household Composition and Disability, Minority Status and Language, and Housing and Transportation.

- Figure 1.7 Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
- Figure 1.25 Areas Within a Two Mile Radius to FQHCs/FQHC Look-Alikes and Social Vulnerability Index, Harris County, TX, 2016.
- Figure 1.27 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
- Figure 1.34 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Social Vulnerability Index, Harris County, TX, 2016.

US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. (n.d.). *Behavioral health treatment services locator* [Facility location]. Retrieved from https://findtreatment.samhsa.gov/locator

- Figure 1.27 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.

SECTION 2: BUILDING RESILIENCE IN HARRIS COUNTY

Centers for Disease Control and Prevention, National Center for Health Statistics. (2010-2015). *US Small-area Life Expectancy Estimates Project (USALEEP)* [Data file]. Retrieved from https://www.cdc.gov/nchs/nvss/usaleep/usaleep.html#data

US Small-area Life Expectancy Estimates Project (USALEEP) estimated life expectancy at birth for the period 2010-2015, by census tract. Death records of US residents (excluding residents of Maine and Wisconsin) for deaths in 2010 to 2015 were geocoded based on descendants' residential addresses. Statistical modeling based on population estimates (2016 American Community Survey (ACS) 5-Year Estimates, US Census Bureau) is used to address issues associated with small population sizes and missing age-specific death counts.

- Figure 2.1 Life Expectancy by Census Tract and PUMA, Harris County, TX, 2010-2015.

Esri Demographics. (2018). *2018 total population* [Spatial data]. Retrieved from https://doc.arcgis.com/en/esri-demographics/data/census-acs.htm

2018 total population is estimated based on US Census 2010 geographies. Note that population density is calculated by normalizing total population by area in square miles.

- Figure 2.12 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Population Density, Harris County, TX, 2018.
- Figure 2.19 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.

Eviction Lab. (2016). *Eviction map and data* [Map services]. Retrieved from https://evictionlab.org/map/#/2016?geography=states

Eviction rate is homes that received an eviction judgment in which renters were ordered to leave, over the number of occupied renting households in each area.

- Figure 2.8 Number of Evictions per Renter-Occupied Household by Census Tract and PUMA, Harris County, TX, 2016.

Greater Harris County 9-1-1 Emergency Network. (2019). *Harris County emergency network* [Web service]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/Emer_Response/EMS_FS/MapServer

- Figure 2.19 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.

Harris County Public Health. *Community Assessment for Public Health Emergency Response (CASPER) community survey* [Survey data]. Houston, TX: Harris County Public Health.

Harris County Public Health conducts Community Assessment for Public Health Emergency Response (CASPER) community surveys annually to assess a community's level of preparedness and level of resilience. Since 2015, HCPH has surveyed 1,689 residents door-to-door and approached 4,796 households in disaster prone neighborhoods through CDC's CASPER assessment process. This well-recognized survey tool CASPER helps county leadership identify the vulnerability, public health risks, needs, and resiliency of communities, neighborhood by neighborhood. Once communities are identified, clusters are grouped, and a systematic random sampling is applied to determine who is approached.

- Figure 2.14 Percentage of Persons Who Consider Their Households "Well-Prepared" to Handle an Emergency, Harris County, TX, 03/2015-06/2019.

Harris County Public Health, Office of Public Health Preparedness and Response. (2019). *2017 EMS calls* [Survey data]. Houston, TX: Harris County Public Health.

The Office of Public Health Preparedness and Response conducted interviews in person and by phone to obtain the call volume at each EMS agency within Harris County for the period during Hurricane Harvey (8/26/2017 - 8/31/2017) and for the entire year of 2017. Using this survey data, we map the number of calls in 2017 per 1,000 people for each EMS service area. On the same map, we also indicate the population for each EMS service area.

- Figure 2.19 Number of EMS Calls per 1,000 People and Population by EMS Area, Harris County, TX, 2017.

Texas Commission on Environmental Quality. (2018-2019). *Texas Air Monitoring Information System (TAMIS) web interface* [Database]. Retrieved from https://www.tceq.texas.gov/goto/tamis

- Figure 2.24 Amount of Air Pollution (lbs.) Released by Zip Code and Chemical, Harris County, TX, 08/27/2018-08/27/2019.

Texas Department of State Health Services, Center for Health Statistics. (2016-2018). *Texas hospital emergency department Public Use Data File (PUDF)* [Data file]. Retrieved from https://www.dshs.texas.gov/thcic/OutpatientFacilities/Texas-Emergency-Department-Data/

Emergency department hospital visits is based on inpatient and outpatient data from the Texas Department of State Health Services. The data includes visits to hospitals and ambulatory surgical centers in which a patient received services that included an invasive surgical procedure or an imaging/radiological procedure, as well as all hospital emergency department visits. The data was filtered to only include Harris County residents, regardless of which reporting facilities they went to. Note that end-stage renal disease visits were based on emergency department visits in which patients received a principal diagnosis of end-stage renal disease.

- Figure 2.20 Number of Total Emergency Department Visits, Harris County, TX, Q1/2016-Q2/2018.
- Figure 2.21 Percentage of Emergency Department Visits Due to End-Stage Renal Disease, Harris County, TX, Q1/2016-Q2/2018.
- Figure 2.22 End-Stage Renal Disease Facilities and Emergency Department Visits Due to End-Stage Renal Disease per 1,000 Visits by Zip Code, 2017.

Texas Department of State Health Services, Center for Health Statistics. (2017). *Texas hospital inpatient discharge Public Use Data File (PUDF) & Texas outpatient surgical and radiological procedure Public Use Data File (PUDF)* [Data files]. Retrieved from https://www.dshs.state.tx.us/thcic/hospitals/Inpatientpudf.shtm

Inpatient hospital visit data is at the patient-level, for patients who were admitted into the hospital for care. Outpatient hospital visit data is at the patient-level, for outpatient services that do not go more than 24 hours from the time they are being treated in the hospital or ambulatory surgery center. The data was filtered to only include Harris County residents, regardless of which reporting facilities they went to. Note that all asthma hospital visits were based on inpatient and outpatient hospital visit data in which patients received a principal diagnosis of asthma. Mental health hospital visits were based on inpatient and outpatient hospital visit data in which patients received at least one diagnosis related to mental health. The methods for preventable hospitalizations are summarized in Section 1.

- Table 2.1 Charges for Specific Preventable Adult Hospitalization Indicators, Harris County, TX, 2017.
- Figure 2.27 Number of Hospital Visits Due to Asthma per 1,000 Visits by Zip Code, 2017.
- Figure 2.33 Change in Percentage of Mental Health Hospitalizations by Zip Code, Harris County, TX, 2013 vs. 2017.

Texas Department of State Health Services, Health and Human Services Commission. (2018/2019). *DSHS licensed facilities* [Facility location]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/HCPHES/DSHS_Licensed_Facilities_FS/FeatureServer

- Figure 2.11 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Social Vulnerability Index, Harris County, TX, 2016.
- Figure 2.12 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Population Density, Harris County, TX, 2018.
- Figure 2.15 Distance to DSHS Licensed Hospitals by Census Block, Harris County, TX, 2019.
- Figure 2.16 Distance to DSHS Licensed Trauma Facilities (Levels I, II, III) by Census Block, Harris County, TX, 2018.
- Figure 2.36 Substance Abuse Treatment Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.

Texas Education Agency. (2017-2018). *Reports and data* [Data file]. Retrieved from https://tea.texas.gov/Reports_and_Data

- Figure 2.34 Number of Students per Mental Health Staff by Independent School District, Harris County, TX, 2017-2018.

The University of Texas School of Public Health. (2010/2018). *Health of Houston 2018* [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/

The Health of Houston Survey 2018 is based on telephone interviews that were conducted between June 2017 and May 2018. N = *5,700 adult respondents were randomly selected in each sub-county geographical stratum in Harris County. Survey responses are weighted to obtain a representative sample of Harris County residents across aggregations of PUMAs and other sociodemographic characteristics.*

- Figure 2.29 Percentage of Adults Reporting Concerns Over Neighborhood Conditions, Harris County, TX, 2010 vs. 2018.
- Figure 2.32 Percentage of Adults Who Had 14 or More Days with Poor Mental Health in the Past 30 Days by PUMA, Harris County, TX, 2018.

United Way of Greater Houston. (2017). *2-1-1 call center data* [Data file]. Houston, TX: United Way of Greater Houston.

- Figure 2.17 Total Calls to 2-1-1 During Hurricane Harvey and Recovery, Harris County, TX, 08/25/2017-11/30/2017.
- Figure 2.18 Top Needs Reported On 2-1-1 Calls During Hurricane Harvey and Recovery, Harris County, TX, 08/25/2017-11/30/2017.

US Census Bureau. *American Community Survey (ACS)* [Data file]. Retrieved from https://factfinder.census.gov/

- Figure 2.5 Percentage of Households with No Vehicles by Census Tract, Harris County, TX, 2017.
- Figure 2.6 Percentage of Commuters That Use Public Transit by Race, Harris County, TX, 2017.
- Figure 2.7 Percentage of Commuters That Use Public Transit by Ethnicity, Harris County, TX, 2017.
- Figure 2.9 Per Capita Income by Census Tract, Harris County, TX, 2017.
- Figure 2.10 Percentage of People Without Health Insurance by Census Tract, Harris County, TX, 2017.
- Figure 2.28 Location of Superfund Sites and the Percentage of Population Below Poverty Line, Harris County, TX, 2017.

US Department of Agriculture, Economic Research Service. (2015). *Food access research atlas* [Mapping tool]. Retrieved from https://www.ers.usda.gov/data-products/food-access-research-atlas/

The Food Access Research Atlas maps low income and low access areas. Food deserts are defined as census tracts that have a substantial number (500 persons or 33% of the population in a census tract) of low-income residents live more than 1 mile from the nearest supermarket if the area is urban or 10 miles if the area is rural. The tool is based on US Census 2010 geographies.

- Figure 2.31 Food Deserts by Census Tract, Harris County, TX, 2015.

US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. (2016). *CDC's Social Vulnerability Index* [Index]. Retrieved from https://svi.cdc.gov/data-and-tools-download.html

The CDC's Social Vulnerability Index uses the 2016 American Community Survey 5-Year Estimates by the US Census Bureau, to determine social vulnerability at the census tract level. The index ranks each census tract on 15 social factors, which are grouped into four themes: Socioeconomic Status, Household Composition and Disability, Minority Status and Language, and Housing and Transportation.

- Figure 2.11 Areas Within a 15 Minute Driving Radius to DSHS Licensed Trauma Facilities (Levels I, II, III) and Social Vulnerability Index, Harris County, TX, 2016.
- Figure 2.13 Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
- Figure 2.35 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.
- Figure 2.36 Substance Abuse Treatment Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.

US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. (n.d.). *Behavioral health treatment services locator* [Facility location]. Retrieved from https://findtreatment.samhsa.gov/locator

- Figure 2.33 Change in Percentage of Mental Health Hospitalizations by Zip Code, Harris County, TX, 2013 vs. 2017.
- Figure 2.35 Mental Health Facilities and Social Vulnerability Index by Census Tract, Harris County, TX, 2016.

US Environmental Protection Agency. (2018). *Environmental Justice Screening and Mapping Tool (EJSCREEN)* [Mapping tool]. Retrieved from https://ejscreen.epa.gov/mapper/

Environmental Justice Screening and Mapping Tool (EJSCREEN) is an environmental justice mapping and screening tool that is based on the National-Scale Air Toxics Assessments (NATA) by the EPA and the 2016 American Community Survey (ACS) 5-Year Estimates by the US Census Bureau. Air toxics cancer risk estimates the lifetime cancer risk from inhaling air toxics and is shown as a rate of risk per lifetime per one million people. Air toxics respiratory hazard index is an aggregate of multiple hazard indices; each hazard index is the air toxics exposure concentration to the health-based reference concentration levels set by EPA. Lead paint indicator is the percentage of housing units that were built prior to 1960, which captures potential exposure to lead paint. Traffic proximity is the number of vehicles per day at major roads, or the average amount of annual daily traffic, within 500 meters, divided by distance in meters.

- Figure 2.4 Cancer Risk from Inhalation of Air Toxics by Census Block, Harris County, TX, 2018.
- Figure 2.23 Cancer Risk from Inhalation of Air Toxics by Census Block, Harris County, TX, 2018.
- Figure 2.25 Air Toxics Respiratory Hazard Index by Census Block, Harris County, TX, 2018.
- Figure 2.26 Traffic Proximity by Census Block, Harris County, TX, 2018.
- Figure 2.30 Lead Paint Indicator by Census Block, Harris County, TX, 2018.

US Environmental Protection Agency. (n.d.). *Superfund* [Superfund site location]. Retrieved from https://www.epa.gov/superfund/search-superfund-sites-where-you-live

- Figure 2.28 Location of Superfund Sites and the Percentage of Population Below Poverty Line, Harris County, TX, 2017.

SECTION 3: HEALTH ISSUES IN HARRIS COUNTY

Annie E. Casey Foundation. (2015). *KIDS COUNT Data Center* [Data center]. Retrieved from https://datacenter.kidscount.org/

- Figure 3.21 Percentage of Women Who Received Late or No Prenatal Care by Race/Ethnicity, Harris County, TX, 2015.

Centers for Disease Control and Prevention, CDC Wide-ranging ONline Data for Epidemiologic Research (CDC WONDER). (1999-2017). *Underlying Cause of Death* [Database]. Retrieved from https://wonder.cdc.gov/

The Underlying Cause of Death database contains mortality counts at the county-level for US residents. Data are based on death certificates, which identifies a single underlying cause of death.

- Figure 3.7 Age-Adjusted Gun-Related Deaths per 100,000 People by Type and Location, Select Urban US Counties, 1999-2017.
- Figure 3.12 Rate of Maternal Mortality per 1,000 Live Births, Harris County, TX, 2007-2017.
- Figure 3.14 Rates of Harris County Infant Mortality per 1,000 Live Births by Race/Ethnicity, Harris County, TX, 2011-2017.

Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System. (2011-2017). *Mortality data* [Data file]. Retrieved from https://www.cdc.gov/nchs/nvss/mortality_methods.htm

- Figure 3.22 Average Teen Births per 1,000 Females (15-19 Years of Age) by Race/Ethnicity, Harris County, TX, 2011-2017.

City of Houston, Houston Health Department. (2019). *COHGIS open data portal* [Facility location]. Retrieved from https://cohgis-mycity.opendata.arcgis.com/datasets/coh-health-department-facilities

- Figure 3.19 Distance to WIC Centers by Census Block, Harris County, TX, 2019.

Harris County Public Health. (2019). *Harris County Public Health facilities* [Facility location]. Retrieved from https://www.gis.hctx.net/arcgis/rest/services/HCPHES/HCPH_Locations_FS/MapServer/0

- Figure 3.19 Distance to WIC Centers by Census Block, Harris County, TX, 2019.

Harris County Public Health, Mosquito Control Division. (2013-2017). *Mosquito pool data* [Data file]. Houston, TX: Harris County Public Health.

- Figure 3.31 Positive Mosquito Pool Count by Mosquito Control Operational Area, Harris County, TX, 2013-2017.
- Table 3.5 West Nile Virus Counts, Mosquito and Human, Harris County, TX, 2013-2017.

Harris County Public Health, Women, Infants and Children Program. (2019). *Breastfeeding rates* [Data file]. Houston, TX: Harris County Public Health.

- Figure 3.18 Annual Rates of Breastfeeding of Babies Enrolled in WIC by Race/Ethnicity, Harris County, TX, 2013-2017.

March of Dimes Perinatal Data Center. (2014-2016). *PeriStats* [Data center]. Retrieved from https://www.marchofdimes.org/peristats/Peristats.aspx

- Figure 3.15 Percentage of Preterm Births, Harris County and Texas, 2014-2016.
- Figure 3.16 Percentage of Preterm Births by Race/Ethnicity, Harris County and Texas, 2014-2016.

Texas Department of State Health Services, Center for Health Statistics. (2015). *Birth outcomes* [Interactive public data system]. Retrieved from http://healthdata.dshs.texas.gov/VitalStatistics/Birth

- Figure 3.17 Percentage of Infants Born with Low Birthweight (<2500 grams) by Race/Ethnicity, Harris County, TX, 2009-2015.
- Figure 3.20 Percentage of Women Who Received Early Prenatal Care, Harris County, TX, 2009-2015.

Texas Department of State Health Services, Center for Health Statistics. (n.d.). *Causes of death for Texas residents* [Interactive public data system]. Retrieved from http://healthdata.dshs.texas.gov/VitalStatistics/Death

The top 15 causes of death for Harris County residents were obtained from the 50 Rankable Causes of Death from the Texas Department of State Health Services. Death data is based on death certificates, which identifies a single underlying cause of death.

- Table 3.2 Top 15 Causes of Death, Harris County, TX, 2015.

Texas Department of State Health Services, Center for Health Statistics. (2017). *Texas hospital inpatient discharge Public Use Data File (PUDF) & Texas outpatient surgical and radiological procedure Public Use Data File (PUDF)* [Data files]. Retrieved from https://www.dshs.state.tx.us/thcic/hospitals/Inpatientpudf.shtm

Inpatient hospital visit data is at the patient-level, for patients who were admitted into the hospital for care. Outpatient hospital visit data is at the patient-level, for outpatient services that do not go more than 24 hours from the time they are being treated in the hospital or ambulatory surgery center. The data was filtered to only include Harris County residents, regardless of which reporting facilities they went to. Note that all of the conditions/diseases in Section 3 that use inpatient and outpatient hospital visit data are based on visits in which patients received at least one diagnosis of the condition/disease of interest. In some instances, procedural codes were used in conjunction with diagnosis codes.

- Figure 3.6 Number of Hospitalizations by Injury Focus Area, Harris County, TX, 2017.
- Figure 3.13 Incidents of Severe Maternal Morbidity (SMM) per 1,000 Delivery Hospitalizations by Zip Code and PUMA, Harris County, TX, 2017.

Texas Department of State Health Services, Infectious Disease Control Unit. (2013-2017). *2017 Texas infectious disease annual report* [PDF file]. Retrieved from https://dshs.texas.gov/idcu/Data/annual/2000s/

- Figure 3.28 Number of Foodborne and Waterborne Illnesses, Harris County, TX, 2013-2017.
- Figure 3.29 Number of Multidrug-Resistant Acinetobacter and Carbapenem-Resistant Enterobacteriaceae, Harris County, TX, 2015-2017.
- Table 3.4 Number of Vaccine-Preventable Disease Cases, Harris County, TX, 2013-2017.
- Figure 3.30 Number of Invasive Streptococcus Infections, Harris County, TX, 2013-2017.
- Table 3.5 West Nile Virus Counts, Mosquito and Human, Harris County, TX, 2013-2017.

Texas Department of State Health Services, TB/HIV/STD Epidemiology and Surveillance Branch. (2013-2017). *Reports* [PDF file]. Retrieved from https://dshs.texas.gov/hivstd/reports/

- Table 3.3 Local and State Tuberculosis Case Counts and Rates, Harris County, TX, 2013-2017.
- Figure 3.25 Number of New HIV Diagnoses by Race and Census Tract, Harris County, TX, 2017.
- Figure 3.26 Change in Number of Persons Living with HIV per 1,000 People by Race and Census Tract, Harris County, TX, 2013 vs. 2017.
- Figure 3.27 Number of Sexually Transmitted Infections, Harris County, TX, 2013-2017.

Texas Department of State Health Services, TB/HIV/STD Epidemiology and Surveillance Branch. (n.d.). *HIV data* [Data file]. Austin, TX: Texas Department of State Health Services.

- Figure 3.25 Number of New HIV Diagnoses by Race and Census Tract, Harris County, TX, 2017.
- Figure 3.26 Change in Number of Persons Living with HIV per 1,000 People by Race and Census Tract, Harris County, TX, 2013 vs. 2017.

Texas Department of Transportation. (2018). *Motor vehicle traffic crash data* [Database]. Retrieved from https://www.txdot.gov/apps-cg/crash_records/form.htm

- Figure 3.9 Location and Timing of Traffic Fatalities, Harris County, TX, 2018.

Texas Education Agency. (2013-2014). *Fitness data* [Data file]. Retrieved from https://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data

Fitness data for Texas students is aggregated by independent school district, for districts and charter schools that submitted

information via the Physical Fitness Assessment Initiative.

- Figure 3.5 Percentage of Students at High Risk of Obesity by Independent School District, Harris County, TX, 2013-2014.
- Table 3.1 Percentage of Students at High Risk of Obesity by Independent School District, Harris County, TX, 2013-2014.

The University of Texas Health Science Center at Houston, McGovern Medical School. (n.d.). *Texas WIC* [Clinic location]. Retrieved from https://med.uth.edu/wic/clinics/

- Figure 3.19 Distance to WIC Centers by Census Block, Harris County, TX, 2019.

The University of Texas School of Public Health. (2018). *Health of Houston 2018* [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/

The Health of Houston Survey 2018 is based on telephone interviews that were conducted between June 2017 and May 2018. N = *5,700 adult respondents were randomly selected in each sub-county geographical stratum in Harris County. Survey responses are weighted to obtain a representative sample of Harris County residents across aggregations of PUMAs and other sociodemographic characteristics.*

- Figure 3.2 Percentage of Adults Who Did Not Meet HHS Physical Activity Guidelines by PUMA, Harris County, TX, 2018.
- Figure 3.3 Percentage of Adults with Diabetes by PUMA, Harris County, TX, 2018.
- Figure 3.4 Percentage of Adults Who Are Considered Obese by PUMA, Harris County, TX, 2018.
- Figure 3.8 Percentage of Adults Who Have Ever Smoked Electronic Cigarettes by PUMA, Harris County, TX, 2018.
- Figure 3.23 Percentage of Children Without Insurance by PUMA, Harris County, TX, 2018.

References

1. Graham, G. N. (2016). Why your ZIP code matters more than your genetic code: Promoting healthy outcomes from mother to child. Breastfeeding Medicine, 11(8), 396-397. doi: 10.1089/bfm.2016.0113
2. City of Houston (2017). A ten-year plan for the City of Houston: A plan for fiscal sustainability and economic growth. Retrieved from http://www.houstontx.gov/finance/COH-Ten-Year-Plan-Report.pdf
3. Lightbourne, J. E. (2017). Consolidation or collaboration? Common solutions to reduce overlapping services in local government. Rice University Kinder Institute for Urban Research. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Consolidation%20or%20Collaboration%20.pdf
4. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
5. World Health Organization (n.d.). Frequently asked questions. Retrieved from https://www.who.int/about/who-we-are/frequently-asked-questions
6. RESOLVE (2014). The high achieving governmental health department in 2020 as the community chief health strategist. Retrieved from http://www.quadcouncilphn.org/wp-content/uploads/2016/03/2015_RESOLVE-Community-Chief-Health-Strategist.pdf
7. U.S. Department of Commerce Bureau of Economic Analysis (2018). GDP by metropolitan area [Data file]. Retrieved from https://www.bea.gov/data/gdp/gdp-metropolitan-area
8. Harris County Budget Management Department (2019). Population report – January 19. Retrieved from https://budget.harriscountytx.gov/doc/Budget/fy2020/approved_budget/FY20_Population_Report.pdf
9. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
10. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
11. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
12. City of Houston (2019). About Houston: Facts and figures. Retrieved from http://www.houstontx.gov/abouthouston/houstonfacts.html
13. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
14. Binkovitz, L. (2016). Asian population is Houston's fastest growing group. Rice University Kinder Institute for Urban Research. Retrieved from https://kinder.rice.edu/2016/09/20/houstons-asian-population-fastest-growing
15. Greater Houston Partnership (2019). Data, insight & analysis. Retrieved from https://www.houston.org/houston-data/talking-points
16. Capps, R., & Ruiz Soto, A. G. (2018). A profile of Houston's diverse immigrant population in a rapidly changing policy landscape. Migration Policy Institute. Retrieved from https://www.migrationpolicy.org/sites/default/files/publications/HoustonImmigrantsProfile_FinalWeb.pdf
17. Capps, R., & Ruiz Soto, A. G. (2018). A profile of Houston's diverse immigrant population in a rapidly changing policy landscape. Migration Policy Institute. Retrieved from https://www.migrationpolicy.org/sites/default/files/publications/HoustonImmigrantsProfile_FinalWeb.pdf
18. Opportunity Insights (n.d.). Data library: Publicly available data we've produced and replication code [Data file]. Retrieved from https://opportunityinsights.org/data/
19. Texas Health Maps (n.d.). Life expectancy by ZIP code in Texas [Visual map]. Retrieved from https://www.texashealthmaps.com/lfex
20. Texas Health Maps (n.d.). Life expectancy in Texas 2005-2014 [PDF report]. Retrieved from https://www.texashealthmaps.com/Life-expectancy-in-Texas-2005-2014.pdf
21. Robert Wood Johnson Foundation. (n.d.). Could where you live influence how long you live? [Web application]. Retrieved from https://www.rwjf.org/lifeexpectancy
22. Robert Wood Johnson Foundation. (n.d.). Could where you live influence how long you live? [Web application]. Retrieved from https://www.rwjf.org/lifeexpectancy
23. Texas Health Maps (n.d.). Life expectancy by ZIP code in Texas [Visual map]. Retrieved from https://www.texashealthmaps.com/lfex
24. Deam, J. & Dempsey, M. (2019). Houston area rate of uninsured highest in nation among big cities – and getting worse. Houston Chronicle. Retrieved from https://www.houstonchronicle.com/business/article/Houston-area-rate-of-uninsured-highest-in-nation-14468575.php
25. Noland, V. J., Troxler, X., & Salemi, A. M. T. (2004).

School health is public health. Florida Public Health Review, 1, 24-29. http://hsc.usf.edu/NR/rdonlyres/2C2130C1-3E71-400E-87E6-CF-374C7E62E7/0/v1pp024_029NolandTroxlerSalemi.pdf
26. Kindig, D. & Stoddart, G. (2003). What is population health? American Journal of Public Health, 93(3), 380-383. doi: 10.2105/ajph.93.3.380
27. Piña, I. L., Cohen, P. D., Larson, D. B., Marion, L. N., Sills, M. R., Solberg, L. I., & Zerzan J. (2015). A framework for describing health care delivery organizations and systems. American Journal of Public Health, 105(4), 670-679. doi: 10.2105/AJPH.2014.301926
28. Niles, N. J. (2011). Basics of the US health care system: Chapter 1 – Overview of the US healthcare delivery system. Sudbury, Massachusetts: Jones and Bartlett Publishers. Retrieved from http://samples.jbpub.com/9781449615192/69840_ch01_niles.pdf
29. Texas Medical Center (n.d.). TMC facts & figures. Retrieved from https://www.tmc.edu/wp-content/uploads/2018/07/TMC_FactsFiguresOnePager_07052018-1.pdf
30. World Health Organization (n.d.). Health systems. Retrieved from https://www.who.int/topics/health_systems/en/
31. World Health Organization (n.d.). Health systems. Retrieved from https://www.who.int/topics/health_systems/en/
32. Houston Health Services Research Collaborative for the Health of Houston Initiative (2010). Harris County health care safety net: Where we stand 2010. Retrieved from https://sph.uth.edu/content/uploads/2011/12/August2011edit.pdf
33. Centers for Disease Control and Prevention (2016). History of smallpox. Retrieved from https://www.cdc.gov/smallpox/history/history.html
34. Marvasti, F. F. & Stafford, R. S. (2012). From “sick care” to health care: Reengineering prevention into the U.S. System. The New England Journal of Medicine, 367(10), 889-891. doi: 10.1056/NEJMp1206230
35. Centers for Disease Control and Prevention (1999). Ten great public health achievements - United States, 1900-1999. Morbidity Mortality Weekly Report, 48(12), 241-243. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/00056796.htm
36. The Centers for Medicare & Medicaid (2019). CMS’ value-based programs. Retrieved from https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/Value-Based-Programs.html
37. NEJM Catalyst (2017). What is value-based healthcare? New Marketplace. Retrieved from https://catalyst.nejm.org/what-is-value-based-healthcare/
38. Swarthout, M. & Bishop, M. A. (2017). Population health management: Review of concepts and definitions. American Journal of Health-System Pharmacy, 74(18), 1405-1411. doi: 10.2146/ajhp170025
39. Institute for Healthcare Improvement (n.d.). Triple aim for populations. Retrieved from http://www.ihi.org/Topics/TripleAim/Pages/default.aspx
40. Harris Health System (n.d.). Bridge to 2020: Strategic plan 2018-2020. Retrieved from https://www.harrishealth.org/SiteCollectionDocuments/financials/strategic-plan-booklet-final.pdf
41. BKD CPAs & Advisors (2019). Harris County hospital district, d/b/a Harris Health System, a component unit of Harris County, Texas: Independent auditor’s report and financial statements. Retrieved from https://www.harrishealth.org/SiteCollectionDocuments/financials/combined/financial-statement-2019.pdf
42. DeSalvo, K. B., Wang, Y. C., Harris, A., Auerbach, J. Koo, D., & O’Carroll, P. (2017). Public health 3.0: A call to action for public health to meet the challenges of the 21st century. Preventing Chronic Disease and NAM Perspectives, 14, 170017. http://dx.doi.org/10.5888/pcd14.170017
43. RESOLVE (2014). The high achieving governmental health department in 2020 as the community chief health strategist. Retrieved from http://www.quadcouncilphn.org/wp-content/uploads/2016/03/2015_RESOLVE-Community-Chief-Health-Strategist.pdf
44. DeSalvo, K. B., Wang, Y. C., Harris, A., Auerbach, J. Koo, D., & O’Carroll, P. (2017). Public health 3.0: A call to action for public health to meet the challenges of the 21st century. Preventing Chronic Disease and NAM Perspectives, 14, 170017. http://dx.doi.org/10.5888/pcd14.170017
45. Revere, L., Large, J., Langland-Orban, B., Zhang, H., Delgando, R., & Amadi, T. (2018). The effect of the Texas Medicaid waiver design and implementation on regional changes in uncompensated care: Part 2. Journal of Health Care Finance, 45(1). Retrieved from http://healthfinancejournal.com/index.php/johcf/article/view/157/161
46. Schlenker, T. & Huber, C. A. (2014). A unique funding opportunity for public health in Texas. Journal of Public Health Management and Practice, 21(Suppl 1), S81-S86. doi: 10.1097/PHH.0000000000000131
47. Texas Health and Human Services Commission Center for Analytics and Decision Support (2018). Texas healthcare transformation and quality improvement program demonstration waiver evaluation design plan. Retrieved from https://hhs.texas.gov/sites/default/files/documents/laws-regulations/policies-rules/1115-docs/tool-guidelines/1115-waiver-evaluation-design-plan.pdf
48. Schlenker, T. & Huber, C. A. (2014). A unique funding opportunity for public health in Texas. Journal of Public Health Management and Practice, 21(Suppl 1), S81-S86. doi: 10.1097/PHH.0000000000000131
49. Texas Hospital Association (2019). A perfect storm in Texas: Access to health care in jeopardy as Texas hospitals face uncertain financial future.
50. Eighty-Sixth Legislature (2019). H.B. no. 1 general appropriations act. Retrieved from https://capitol.texas.gov/tlodocs/86R/billtext/pdf/HB00001F.pdf#navpanes=0
51. Texas Hospital Association (n.d.). 1115 Medicaid transformation waiver. Retrieved from https://www.tha.org/waiver
52. County Health Rankings & Roadmaps (2016). County health rankings model. Retrieved from https://www.countyhealthrankings.org/county-health-rankings-model
53. The Build Health Challenge (n.d.). Getting BUILD ready: Tools and feedback survey. Retrieved from https://buildhealthchallenge.org/resources/getting-build-ready/

54. Hanleybrown, F., Kania, J., & Kramer, M. (2012). Channeling change: Making collective impact work. Stanford Social Innovation Review. Retrieved from https://www.keywestchamber.org/uploads/4/6/5/2/46520599/channeling_change_pdf-ssi-article-2012.pdf
55. Healthy Living Matters (n.d.). Health living matters - Pasadena. Retrieved from http://www.healthylivingmatters.net/cms/one.aspx?pageId=69776
56. The Build Health Challenge (n.d.). Case study: Harris County BUILD health partnership. Retrieved from https://buildhealthchallenge.org/resources/case-study-harris-county-build-health-partnership/
57. McAshan, B. R. (2019). Cultivating a food farmacy. TMC News. Retrieved from https://www.tmc.edu/news/2019/06/cultivating-a-food-farmacy/
58. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
59. Gulzar, L. (1999). Access to health care. The Journal of Nursing Scholarship, 31(1), 13-9. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10081206
60. Office of Disease Prevention and Health Promotion (n.d.). Access to health services. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/Access-to-Health-Services
61. Wyszewianski, L. & McLaughlin, C. G. (2002). Access to care: Remembering old lessons. Health Services Research, 37(6), 1441-1443. doi: 10.1111/1475-6773.12171
62. Cook, N. L., Hicks, L. S., O'Malley, A. J., Keegan, T., Guadagnoli, E., & Landon, B. E. (2007). Access to specialty care and medical services in community health centers. Health Affairs, 26(5), 1459-1468. doi:10.1377/hlthaff.26.5.1459
63. Ezeonwu, M. C. (2018). Specialty-care access for community health clinic patients: Processes and barriers. Journal of Multidisciplinary Healthcare, 11, 109-119. doi:10.2147/JMDH.S152594
64. Nakamura, Y., Laberge, M., Davis, A., & Formoso, A. (2019). Barriers and strategies for specialty care access through federally qualified health centers: A scoping review. Journal of Health Care for the Poor and Underserved, 30(3), 910-933. doi: 10.1353/hpu.2019.0064
65. Pugil, J., McArthur, K., Sinclair B., & Reynolds, T. (2019). A decade of healthcare in Harris County: Community health center trends, 2018-2017. Retrieved from https://www.episcopalhealth.org/files/1115/5655/8251/2019-Community-Clinic-Presentation_v2.pdf
66. North Texas Regional Extension Center (2015). The physician workforce in Texas: An examination of physician distribution, access, demographics, affiliations, and practice patterns in Texas' 254 counties. Retrieved from https://dfwhcfoundation.org/wp-content/uploads/2015/04/mhaNTREC-2015studyfinal.pdf
67. University of Houston (2018). College of Medicine Report. Retrieved from http://www.uh.edu/medicine/_documents/college-of-medicine-report-v2.pdf
68. Texas Medical Board (2019). Licensed physician database [Data File]. Retrieved from http://orssp.tmb.state.tx.us/
69. Mathews, C. (2019). UH releases new medical school renderings, holds bill signing ceremony with Gov. Abbott. Houston Business Journal. Retrieved from https://www.bizjournals.com/houston/news/2019/08/21/uh-releases-new-medical-school-renderings-holds.html
70. American Academy of Family Physicians (n.d.). Primary care. Retrieved from https://www.aafp.org/about/policies/all/primary-care.html
71. Health Resources and Services Administration Data Warehouse (2018). Data explorer [Data file]. Retrieved from https://data.hrsa.gov/tools/data-explorer
72. Morse, S. (n.d.). Top healthcare construction projects of 2015; Building surges as demand picks up, Revista says. Healthcare Finance News. Retrieved from https://www.healthcarefinancenews.com/news/top-healthcare-construction-projects-2015-buidling-surges-demand-picks-revista-says
73. Houston Health Services Research Collaborative for the Health of Houston Initiative (2010). Harris County health care safety net: Where we stand 2010. Retrieved from https://sph.uth.edu/content/uploads/2011/12/August2011edit.pdf
74. Pugil, J., McArthur, K., Sinclair B., & Reynolds, T. (2019). A decade of healthcare in Harris County: Community health center trends, 2018-2017. Retrieved from https://www.episcopalhealth.org/files/1115/5655/8251/2019-Community-Clinic-Presentation_v2.pdf
75. The Meadows Mental Health Policy Institute (2017). Harris County mental health services for children, youth, and families: 2017 system assessment. Retrieved from https://www.houstonendowment.org/wp-content/uploads/Harris-County-Mental-Health-Services-for-Children-2017-Assessment-embargoed.pdf
76. Substance Abuse and Mental Health Services Administration (n.d). Behavioral health treatment services locator. US Department of Health and Human Services. Retrieved from https://findtreatment.samhsa.gov/
77. UTHealth University of Texas Health Science Center at Houston Harris County Psychiatric Center (n.d.). Public mental health system in Harris County. Retrieved from https://hcpc.uth.edu/pages/public-mentalhealth/
78. The Meadows Mental Health Policy Institute (2017). Harris County mental health services for children, youth, and families: 2017 system assessment. Retrieved from https://www.houstonendowment.org/wp-content/uploads/Harris-County-Mental-Health-Services-for-Children-2017-Assessment-embargoed.pdf
79. Ahmedani, B. K., Simon, G. E., Stewart, C., Beck, A., Waitzfelder, B. E., Rossom, R., … et al. (2014). Health care contacts in the year before suicide death. Journal of General Internal Medicine, 29(6), 870–877. doi: 10.1007/s11606-014-2767-3
80. The Meadows Mental Health Policy Institute (2017). Harris County mental health services for children, youth, and families: 2017 system assessment. Retrieved from https://www.houstonendowment.org/wp-content/uploads/Harris-County-Mental-Health-Services-for-Children-2017-Assessment-embargoed.pdf

81. Wyszewianski, L. & McLaughlin, C. G. (2002). Access to care: Remembering old lessons. Health Services Research, 37(6), 1441-1443. doi: 10.1111/1475-6773.12171
82. NeedyMeds (2019). Free/Low-Cost/Sliding Scale Clinics [Data file]. Retrieved from https://www.needymeds.org/licensing
83. NeedyMeds (2019). Free/Low-Cost/Sliding Scale Clinics [Data file]. Retrieved from https://www.needymeds.org/licensing
84. U.S. Citizenship and Immigration Services (2019). Public charge fact sheet. Retrieved from https://www.uscis.gov/news/fact-sheets/public-charge-fact-sheet
85. Kaiser Family Foundation (2019). Changes to "public charge" inadmissibility rule: Implications for health and health coverage. Retrieved from https://www.kff.org/disparities-policy/fact-sheet/public-charge-policies-for-immigrants-implications-for-health-coverage/
86. Katz, M. H., & Chokshi, D. A. (2018). The "public charge" proposal and public health. The Journal of the American Medical Association, 320(20), 2075. doi: 10.1001/jama.2018.16391
87. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
88. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
89. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey 2017-2018 [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/
90. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
91. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
92. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
93. Texas Medical Association (2018). Vision, mission, and goals. Retrieved from https://www.texmed.org/Template.aspx?id=5
94. Perry, M., Kannel, S., Valdez, R. B., and Chang, C. (2000). Medicaid and children: overcoming barriers to enrollment - findings from a national survey. Kaiser Family Foundation. Retrieved from https://www.kff.org/wp-content/uploads/2013/01/medicaid-and-children-overcoming-barriers-to-enrollment-report.pdf
95. Dunkelberg, A. & O'Malley, M. (2004). Children's Medicaid and SCHIP in Texas: Tracking the impact of budget cuts. Kaiser Family Foundation. Retrieved from https://www.kff.org/wp-content/uploads/2013/01/children-s-medicaid-and-schip-in-texas-tracking-the-impact-of-budget-cuts-report.pdf
96. US Census Bureau (n.d.). American Community Survey (ACS) 2013-2017 [Data file]. Retrieved from https://factfinder.census.gov/
97. Kaiser Family Foundation (2018). Percent of private sector establishments that offer health insurance to employees. Retrieved from https://www.kff.org/other/state-indicator/percent-of-firms-offering-coverage/
98. The University of Texas Health Science Center at Houston UTHealth School of Public Health Institute for Health Policy (2019). Health of Houston survey 2017-2018: A brief summary. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/HHS2018%20final%20report_9-6-2019.pdf
99. HealthCare.gov (n.d.). Medicaid expansion & what it means for you. Retrieved from https://www.healthcare.gov/medicaid-chip/medicaid-expansion-and-you/
100. Kaiser Family Foundation (2019). Status of state Medicaid expansion decisions: Interactive map. Retrieved from https://www.kff.org/medicaid/issue-brief/status-of-state-medicaid-expansion-decisions-interactive-map/
101. The Commonwealth Fund (2019). Underinsured rate rose from 2014-2018, with greatest growth among people in employer health plans. Retrieved from https://www.commonwealthfund.org/press-release/2019/underinsured-rate-rose-2014-2018-greatest-growth-among-people-employer-health
102. The Commonwealth Fund (n.d.). Biennial health insurance surveys. Retrieved from https://www.commonwealthfund.org/series/biennial-health-insurance-surveys
103. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey 2017-2018 [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/
104. Deam, J. (2019). Texas protection against surprised medical bills hits snag, backers fear a loophole, Houston Chronicle. Retrieved from https://www.houstonchronicle.com/business/article/Texas-protection-against-surprise-medical-bills-14487729.php
105. US Department of Health and Human Services Center for Medicare & Medicaid Services (n.d.). Take action using section 1332 waivers: What states need to know. Retrieved from https://www.cms.gov/CCIIO/Programs-and-Initiatives/State-Innovation-Waivers/Downloads/Take-Action-Using-1332-Waivers.pdf
106. McChesney, M. (2019). Texas enrollment in Affordable Care Act health insurance marketplace declines, but local efforts make a positive impact, Center for Public Policy Priorities. Retrieved from http://bettertexasblog.org/wp-content/uploads/2019/07/2019ACAEnrollmentBrief_final.pdf
107. US Department of Health and Human Services Center for Medicare & Medicaid Services (n.d.). Take action using section 1332 waivers: What states need to know. Retrieved from https://www.cms.gov/CCIIO/Programs-and-Initiatives/State-Innovation-Waivers/Downloads/Take-Action-Using-1332-Waivers.pdf
108. Kaiser Family Foundation (2019). Tracking section 1332 state innovation waivers. Retrieved from https://www.kff.org/health-reform/fact-sheet/tracking-section-1332-state-innovation-waivers/
109. Texas Department of Insurance (n.d.). Texas waiver options and implementation analysis. Retrieved from https://www.tdi.texas.gov/reports/docu-

ments/Waiver-Option.pdf
110. Texas Legislature Online History (2015). Bill: SB 200; Legislative session: 84(R). Retrieved from https://capitol.texas.gov/BillLookup/History.aspx?LegSess=84R&Bill=SB200
111. Harris Health System (n.d). Facts and figures. Retrieved from https://www.harrishealth.org/about-us-hh/who-we-are/Pages/statistics.aspx
112. Community Health Choice (n.d.). About us. Retrieved from https://www.communityhealthchoice.org/en-us/about-us/
113. Turner, A. (2018). The business case for racial equity: A strategy for growth. W.K. Kellogg Foundation. Retrieved from http://ww2.wkkf.org/2018/bcfre/BCRE-National-Report.pdf
114. Turner, A. (2018). The business case for racial equity: A strategy for growth. W.K. Kellogg Foundation. Retrieved from http://ww2.wkkf.org/2018/bcfre/BCRE-National-Report.pdf
115. McCullough, J. M. (2018). The return on investment of public health system spending, Academy Health. Retrieved from https://www.academyhealth.org/sites/default/files/roi_public_health_spending_june2018.pdf
116. McCullough, J. M. (2018). The return on investment of public health system spending, Academy Health. Retrieved from https://www.academyhealth.org/sites/default/files/roi_public_health_spending_june2018.pdf
117. Erwin, P., Mays, G., & Riley, W. (2011). Resources that may matter: The impact of local health department expenditures on health status. Public Health Report, 127(1), 89-95. doi: 10.1177/003335491212700110
118. Sisko, A. M., Keehan, S. P., Poisal, J. A., Cuckler, G. A., Smith, S. D., Madison, A. J., … et. al. (2019). National health expenditure projections, 2018-2027: Economic and demographic trends drive spending and enrollment growth, Health Affairs, 38(3). https://doi.org/10.1377/hlthaff.2018.05499
119. Masters, R., Anwar, E., Collins, B., Cookson, R., and Capewell, S. (2017). Return on investment of public health interventions: A systematic review. Journal of Epidemiology and Community Health, 71(8), 827-834. doi: 10.1136/jech-2016-208141
120. Bekemeier, B., Yang, Y., Dunbar, M., Pantazis, A., & Grembowski, D. (2014). Targeted health department expenditures benefit birth outcomes at the county level. American Journal of Preventative Medicine, 46(6), 569-577. doi: 10.1016/j.amepre.2014.01.023
121. Smith, M., Miller, K., & Raetzman, S. (2018). The excess cost of premature or low birthweight births and complicated deliveries to Medicaid. IBM Watson Health. Retrieved from https://www.ibm.com/downloads/cas/WWDZPDL2
122. Marvasti, F. F. & Randall, S. S. (2012). From sick care to health care – Reengineering prevention into the US system. The New England Journal of Medicine, 367(10), 889-891. doi: 10.1056/NEJMp1206230
123. Shah, U. A. (2019). Defending the homeland from bioterrorism: Are we prepared? House Homeland Security Committee – Subcommittee on Emergency Preparedness, Response, & Recovery Testimony. Retrieved from https://homeland.house.gov/imo/media/doc/HCPH_U_Shah_MD_House_Homeland_Security_Cmte_Testimony_2019_Oct_17_(FINAL).pdf
124. Rudolph, L. Ben-Moshe, K., Caplan, J., & Dilon, L. (2013). Health in all policies: A guide for state and local governments. American Public Health Association and Public Health Institute. Retrieved from https://www.phi.org/uploads/files/Health_in_All_Policies-A_Guide_for_State_and_Local_Governments.pdf
125. Fingar, K. R.,Barrett, M. L., Elixhauser, A., Stocks, C., and Steiner, C. A. (2015). Trends in potentially preventable inpatient hospital admissions and emergency department visits. Healthcare Cost and Utilization Project. Retrieved from https://www.hcup-us.ahrq.gov/reports/statbriefs/sb195-Potentially-Preventable-Hospitalizations.pdf
126. Texas Medical Association (2019). The uninsured in Texas. Retrieved from https://www.texmed.org/uninsured/
127. Raven, M. C., Lowe, R. A., & Maselli, J. (2013). Comparison of presenting complaining vs discharge diagnosis for identifying “nonemergency” emergency department visits. The Journal of the American Medical Association, 309(11). 1145-1153. doi: 10.1001/jama.2013.1948
128. Rui, P., Kang, K., & Ashman, J.J. (2016). National hospital ambulatory medical care survey: 2016 emergency department summary tables. Retrieved from https://www.cdc.gov/nchs/data/nhamcs/web_tables/2016_ed_web_tables.pdf
129. Hwang, W., Liao, K., Griffin, L., & Foley, K. L. (2012). Do free clinics reduce unnecessary emergency department visits? The Virginian experience. Journal of Health Care for the Poor and Underserved, 23(3), 1189-1204. Doi: 10.1353/hpu.2012.0121
130. Bindman, A. B., Grumbach, K., Osmond, D., Komaromy, M., Vranizan, K., Lurie, N., … et al. (1995). Preventable hospitalizations and access to health care. Journal of the American Medical Association, 274(4), 305–311. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/7609259
131. Centers for Disease Control and Prevention (2011). CDC health disparities and inequalities report – United States, 2011. Morbidity and Mortality Weekly Report, 60(1), 1-2. Retrieved from https://www.cdc.gov/mmwr/pdf/other/su6001.pdf
132. Ho, V., Metcalfe, L., Dark, C., Vu, L., Weber, E., Shelton, G., … et al. (2017). Comparing utilization and costs of care in freestanding emergency departments, hospital emergency departments, and urgent care centers. Annals of Emergency Medicine, 70(6), 846-857. https://doi.org/10.1016/j.annemergmed.2016.12.006
133. Post, M. (2019). Comprehensive annual financial report, Harris County, Texas: For the year ended February 28, 2019. Retrieved https://auditor.harriscountytx.gov/CAFR/Harris%20County%20FY2019.pdf
134. Urgent Care Association (2019). Benchmarking report: Industry reports – 2018 benchmark survey. Retrieved from https://www.ucaoa.org/Resources/Industry-Reports/Benchmarking
135. UnitedHealth Group (2017). Freestanding emergency departments: Treating common conditions at emergency prices. Retrieved from https://www.unitedhealthgroup.com/content/dam/UHG/PDF/2017/Freestanding-ER-Cost-Analysis.pdf

136. Ho, V., Metcalfe, L., Dark, C., Vu, L., Weber, E., Shelton, G., … et al. (2017). Comparing utilization and costs of care in freestanding emergency departments, hospital emergency departments, and urgent care centers. Annals of Emergency Medicine, 70(6), 846-857. https://doi.org/10.1016/j.annemergmed.2016.12.006
137. Hennepin Health (2019). Health reform. Retrieved from https://www.hennepinhealth.org/about-us/health-reform
138. Milligen, M. V., Mitchell, J. P., Tucker, J., Arkedis, J., & Caravalho, D. (2014). An analysis of prehospital emergency medical services as an essential service and as a public good in economic theory. US Department of Transportation: National Highway Traffic Safety Administration. Retrieved from https://www.ems.gov/pdf/advancing-ems-systems/Reports-and-Resources/Prehospital_EMS_Essential_Service_And_Public_Good.pdf
139. Texas Department of State Health Services (2016-2018). Texas hospital emergency department public use data file (PUDF) [Data file]. Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/OutpatientFacilities/Texas-Emergency-Department-Data/
140. Sheikh-Hamad, D., Paiuk, E., Wright, A. J., Kleinmann, C., Khosla, U., & Shandera, W. X. (2007). Care for immigrants with end stage renal disease in Houston: a comparison of two practices. Texas Medicine, 103(4), 54-58. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/17494250
141. Nuila, R. (2015). Why Harris County takes care of its own – papers or no papers. Houston Chronicle. Retrieved from https://www.houstonchronicle.com/local/gray-matters/article/Undocumented-immigrants-The-ER-And-Harris-6535123.php
142. Charnow, J. A. (2017). Dialysis care in an emergency: Lessons from Hurricane Harvey. Renal and Urology News. Retrieved from https://www.renalandurologynews.com/home/news/nephrology/hemodialysis/dialysis-care-in-an-emergency-lessons-from-hurricane-harvey/
143. Chron Staff (2017). Methodist Sugar Land remained open during Harvey. Retrieved from https://www.chron.com/neighborhood/sugarland/business/article/Methodist-Sugar-Land-remained-open-during-Harvey-12229600.php
144. Texas Department of State Health Services Mental Health and Substance Abuse Division (2007). Tobacco prevention and control strategic plan for 2008-2013. Retrieved from https://www.dshs.texas.gov/legislative/Appx_B_Tobacco_Strat_Plan_08.pdf
145. United Health Foundation America's Health Rankings (n.d.). Public health impact: Smoking – Annual report. Retrieved from https://www.americashealthrankings.org/explore/annual/measure/Smoking/state/ALL
146. American Cancer Society Workplace Solutions (n.d.). Freshstart. Retrieved from https://www.acsworkplacesolutions.com/freshstart.asp
147. DeSalvo, K., Levi, J., Hoagland, B., & Parekh, A. (2018). Developing a financing system to support public health infrastructure. Public Health Leadership Forum. Retrieved from https://www.resolve.ngo/docs/developing-a-financing-system-to-support-foundational-public-health-capabilities-final-draft-10.2.pdf
148. Shih, A., Davis, K., Schoenbaum, S., Gauthier, A., Nuzum, R., & McCarthy, D. (2008). Organizing the US health care delivery system for high performance. The Commonwealth Fund. Retrieved from https://www.dphu.org/uploads/attachements/books/books_1024_0.pdf
149. Hindery, R. (2008). CDC director calls for sweeping health reform. University of California San Francisco. Retrieved from https://www.ucsf.edu/news/2008/12/7936/cdc-director-calls-sweeping-health-reform
150. Hindery, R. (2008). CDC director calls for sweeping health reform. University of California San Francisco. Retrieved from https://www.ucsf.edu/news/2008/12/7936/cdc-director-calls-sweeping-health-reform
151. Heath, S. (2018). Driving health equity in value-based care payment models, Patient Engagement HIT. Retrieved from https://patientengagementhit.com/news/driving-health-equity-in-value-based-care-payment-models
152. Health Services Los Angeles County (n.d) Housing for Health. Retrieved from http://dhs.lacounty.gov/wps/portal/dhs/housingforhealth
153. Cherelus, G. (2019). New York City launches $100 million universal health insurance program. Reuters. Retrieved from https://www.reuters.com/article/us-new-york-healthcare/new-york-city-launches-100-million-universal-health-insurance-program-idUSKCN1P21WF
154. Graham, G. N. (2016). Why your ZIP code matters more than your genetic code: Promoting healthy outcomes from mother to child. Breastfeeding Medicine, 11(8), 396-397. doi: 10.1089/bfm.2016.0113
155. Texas Medical Center (n.d.). Facts and figures. Retrieved from https://www.tmc.edu/about-tmc/facts-and-figures/
156. Pugil, J., McArthur, K., Sinclair B., & Reynolds, T. (2019). A decade of healthcare in Harris County: Community health center trends, 2018-2017. Retrieved from https://www.episcopalhealth.org/files/1115/5655/8251/2019-Community-Clinic-Presentation_v2.pdf
157. Japsen, B. (2019). Poll: Two-thirds of Texas support Medicaid expansion. Forbes. Retrieved from https://www.forbes.com/sites/brucejapsen/2019/03/04/poll-two-thirds-of-texans-support-medicaid-expansion/#1f90bb206cc6
158. San Francisco Department of Public Health (2019). Healthy San Francisco. Retrieved from https://healthysanfrancisco.org/
159. Los Angeles County Department of Health Services (n.d.). My Health LA. Retrieved from http://dhs.lacounty.gov/wps/portal/dhs/mhla
160. City of Houston (2017). A ten-year plan for the City of Houston: A plan for fiscal sustainability and economic growth. Retrieved from http://www.houstontx.gov/finance/COH-Ten-Year-Plan-Report.pdf
161. Lightbourne, J. E. (2017). Consolidation or collaboration? Common solutions to reduce overlapping services in local government. Rice University Kinder Institute for Urban Research. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Consolidation%20or%20Collaboration%20.pdf
162. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development

in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf

163. Hare, A., Kiger, J., & McClendon, M. (2018). Community resilience: Focusing efforts in disaster response. Harris County Public Health Office of Public Health Preparedness and Response. Retrieved from https://www.preparingtexas.org/Resources/documents/TDEM%20Training/2018%20Conference%20Presentations/Community%20Resilience.pdf
164. Boston Public Health Commission (n.d.). Health disparities vs. health inequities. Retrieved from https://www.bphc.org/whatwedo/health-equity-social-justice/what-is-health-equity/Pages/Health-Disparities-vs.-Health-Inequities.aspx
165. National Academies of Sciences, Engineering, & Medicine (2017). Communities in action: Pathways to health equity. Washington, DC: The National Academies Press. Doi: 10.17226/24624
166. Ramirez, L. K. B., Baker, E. A., & Metzler, M. (2008). Promoting health equity: A resource to help communities address social determinants of health. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/nccdphp/dch/programs/healthycommunitiesprogram/tools/pdf/SDOH-workbook.pdf
167. County Health Rankings & Roadmaps (2019). 2019 county health rankings key findings report. Retrieved from https://www.countyhealthrankings.org/
168. Shah, U. A. (2019). Defending the homeland from bioterrorism: Are we prepared? House Homeland Security Committee – Subcommittee on Emergency Preparedness, Response, & Recovery Testimony. Retrieved from https://homeland.house.gov/imo/media/doc/HCPH_U_Shah_MD_House_Homeland_Security_Cmte_Testimony_2019_Oct_17_(FINAL).pdf
169. Braveman, P. (2014). What are health disparities and health equity? We need to be clear. Public Health Reports, 129(Suppl 2), 5-8. doi: 10.1177/00333549141291S203
170. Harris County Judge: Lina Hidalgo (n.d.). Voices heard: The people of Harris County speak – The talking transition: Survey report. Retrieved from http://cjo.harriscountytx.gov/Portals/54/talkingTransition/Talking%20Transition%20Harris%20County%20Survey%20Report%20FINAL%20FINAL%20-%206.18.19.pdf?ver=2019-06-20-101854-233
171. Harris County Judge: Lina Hidalgo (n.d.). Talking transition. Retrieved from http://cjo.harriscountytx.gov/Talking-Transition
172. Harris County Judge: Lina Hidalgo (n.d.). Talking transition. Retrieved from http://cjo.harriscountytx.gov/Talking-Transition
173. Harris County Judge: Lina Hidalgo (n.d.). Talking transition. Retrieved from http://cjo.harriscountytx.gov/Talking-Transition
174. Harris County Judge: Lina Hidalgo (n.d.). Talking transition. Retrieved from http://cjo.harriscountytx.gov/Talking-Transition
175. Harris County Judge: Lina Hidalgo (n.d.). Talking transition. Retrieved from http://cjo.harriscountytx.gov/Talking-Transition
176. Harris County Public Health (n.d.). Pathway: A guide to clinical screening for social determinants of health. Retrieved from http://publichealth.harriscountytx.gov/Portals/27/Documents/Organization/OPP/Pathway%20Executive%20Summary%202018.pdf?ver=2018-02-22-101018-043
177. Prevention Institute (n.d.). Accountable communities for health (ACH). Retrieved from https://www.preventioninstitute.org/projects/accountable-communities-health-ach
178. US Green Building Council – Los Angeles (2016). Building resilience Los Angeles: A primer for facilities. Retrieved from https://static1.squarespace.com/static/57dc2456e58c62e05fee0316/t/58177cb7725e25ba06357b20/1477934275541/10-24-2016_BuildingResiliency-LA.pdf
179. Federal Emergency Management Agency (2019). National incident management system. Retrieved from https://www.fema.gov/national-incident-management-system
180. Casey, D. (n.d.). Local health authority in Texas. Department of State Health Services. Retrieved from https://www.gchd.org/home/showdocument?id=3768#targetText=A%20health%20authority%20is%20a,within%20the%20appointing%20body's%20jurisdiction.
181. Agency for Toxic Substances and Disease Registry (2018). CDC's social vulnerability index (SVI). Centers for Disease Control and Prevention. Retrieved from https://svi.cdc.gov/
182. US Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response (2018). Funding and grant opportunities [Budget reports and funding opportunities]. Retrieved from https://www.phe.gov/Preparedness/planning/hpp/Pages/funding.aspx
183. US Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response (2016). 2017-2022 Health care preparedness and response capabilities. Retrieved from https://www.phe.gov/Preparedness/planning/hpp/reports/Documents/2017-2022-health-care-pr-capablities.pdf
184. Centers for Disease Control and Prevention (n.d.). 2017-2022 hospital preparedness program (HPP) – public health emergency preparedness (PHEP) cooperative agreement. Retrieved from https://www.cdc.gov/cpr/readiness/00_docs/PHEP-Funding-CDC-RFA-TP17-1701.pdf
185. Southeast Texas Regional Advisory Council (n.d.). Regional healthcare preparedness coalition. Retrieved from https://www.setrac.org/regional-healthcare-preparedness-coalition/
186. HISTORY (2019). Gunman opens fire on Las Vegas concert crowd, wounding hundreds and killing 58. This Day in History. Retrieved from https://www.history.com/this-day-in-history/2017-las-vegas-shooting
187. Begley, D. (2017). Starting with Harvey, Lyft provides 'relief rides' during emergencies. Houston Chronicle. Retrieved from https://www.houstonchronicle.com/news/transportation/article/Starting-with-Harvey-Lyft-provides-relief-12380308.php
188. Rice University Children's Environmental Health Initiative (2019). Hurricane Harvey registry initial report. Retrieved from https://cehi.rice.edu/sites/g/files/bxs176/f/u14/KI%20Research%20Report%E2%80%93Hurricane%20Harvey%20Registry%208.pdf
189. Rice University Children's Environmental Health

Initiative (2019). Hurricane Harvey registry initial report. Retrieved from https://cehi.rice.edu/sites/g/files/bxs176/f/u14/KI%20Research%20Report%E2%80%93Hurricane%20Harvey%20Registry%208.pdf
190. American Planning Association: Washington Chapter (2015). The effect of climate change on disaster preparedness. Retrieved from https://www.washington-apa.org/assets/docs/2015/Ten_Big_Ideas/cc-disaster-preparedess.pdf
191. National Center for Disaster Preparedness (2016). Climate change, disasters, and adaptation preparedness. Earth Institute: Columbia University. Retrieved from https://ncdp.columbia.edu/ncdp-perspectives/climate-change-disasters-and-adaptation-preparedness/
192. National Center for Disaster Preparedness (2016). Climate change, disasters, and adaptation preparedness. Earth Institute: Columbia University. Retrieved from https://ncdp.columbia.edu/ncdp-perspectives/climate-change-disasters-and-adaptation-preparedness/
193. Baddour, D. (2015). Houston ranks among the most disaster-prone cities in the country. Houston Chronicle. Retrieved from https://www.chron.com/news/science-environment/article/Houston-ranks-among-most-disaster-prone-cities-in-6033071.php
194. Pruss-Ustun, A., Wolf, J., Corvalan, C., Neville, T., Bos, R., & Neira, M. (2017). Diseases due to unhealthy environments: an updated estimate of the global burden of disease attributable to environmental determinants of health. Journal of Public Health, 39(3), 464-475. doi: 10.1093/pubmed/fdw085
195. Rappaport, S. M. & Smith, T. M. (2010). Environment and disease risks. Science, 330(6003), 460-461. doi: 10.1126/science.1192603
196. Harris County Public Health (2019). CHNA-CHA Review
197. Center for Science and Democracy at the Union of Concerned Scientists and Texas Environmental Justice Advocacy Services (2016). Double jeopardy in Houston: Acute and chronic chemical exposures pose disproportionate risks for marginalized communities. Retrieved from https://www.ucsusa.org/sites/default/files/attach/2016/10/ucs-double-jeopardy-in-houston-full-report-2016.pdf
198. American Lung Association (2019). State of the air 2019, 20th Anniversary. Retrieved from https://www.lung.org/assets/documents/healthy-air/state-of-the-air/sota-2019-full.pdf
199. Galveston Bay Foundation and Houston Advanced Research Center (2018). Galveston bay report card. Retrieved from https://www.harcresearch.org/work/Galveston_Bay_Report_Card
200. Harris County Public Health (2019). CHNA-CHA Review
201. Center for Science and Democracy at the Union of Concerned Scientists and Texas Environmental Justice Advocacy Services (2016). Double jeopardy in Houston: Acute and chronic chemical exposures pose disproportionate risks for marginalized communities. Retrieved from https://www.ucsusa.org/sites/default/files/attach/2016/10/ucs-double-jeopardy-in-houston-full-report-2016.pdf
202. Environmental Protection Agency (2018). Environmental justice screening and mapping tool (version 2018). Retrieved from https://ejscreen.epa.gov/mapper
203. Pruss-Ustun, A., Wolf, J., Corvalan, C., Neville, T., Bos, R., and Neira, M. (2017). Diseases due to unhealthy environments: an updated estimate of the global burden of disease attributable to environmental determinants of health. Journal of Public Health. 39(3), 464-475. doi: 10.1093/pubmed/fdw085
204. Harris County Public Health (2019). CHNA-CHA Review
205. Raun, L. H., Ensor, K. B., Campos, L. A., & Persse, D. (2015). Factors affecting ambulance utilization for asthma attack treatment: understanding where to target interventions. Public Health, 129(5), 501-508. doi: 10.1016/j.puhe.2015.02.009
206. Environmental Protection Agency (2019). Air topics. Retrieved from https://www.epa.gov/environmental-topics/air-topics
207. American Lung Association (2019). State of the air 2019, 20th Anniversary. Retrieved from https://www.lung.org/assets/documents/healthy-air/state-of-the-air/sota-2019-full.pdf
208. Environmental Protection Agency (2018). Releases: Chemical report [Select 2017 national analysis dataset]. TRI Explorer. Retrieved from https://enviro.epa.gov/triexplorer/tri_release.chemical
209. Environmental Protection Agency (2018). Environmental justice screening and mapping tool (Version 2018). Retrieved from https://ejscreen.epa.gov/mapper
210. PENTA Consortium, LLC (2019). Harris county multi-agency coordinating group gap analysis. Retrieved from https://www.readyharris.org/Portals/43/PDFs/Harris%20County%20Gap%20Analysis%20Report%20-%20Updated%20and%20optimized.pdf?ver=2019-07-25-155525-513
211. Chemical Safety and Hazard Investigation Board (2018). Investigation report: Organic peroxide decomposition, release, and fire at Arkema Crosby following Hurricane Harvey flooding. Report number: 2017-08-I-TX. Retrieved from http://www.csb.gov/file.aspx?DocumentId=6063
212. Chemical Safety and Hazard Investigation Board (2018). Investigation report: Organic peroxide decomposition, release, and fire at Arkema Crosby following Hurricane Harvey flooding. Report number: 2017-08-I-TX. Retrieved from http://www.csb.gov/file.aspx?DocumentId=6063
213. PENTA Consortium, LLC (2019). Harris county multi-agency coordinating group gap analysis. Retrieved from https://www.readyharris.org/Portals/43/PDFs/Harris%20County%20Gap%20Analysis%20Report%20-%20Updated%20and%20optimized.pdf?ver=2019-07-25-155525-513
214. Agency for Toxic Substances and Disease Registry (2007). Public health statement benzene CAS#: 71-43-2. Retrieved from https://www.atsdr.cdc.gov/ToxProfiles/tp3-c1-b.pdf
215. Agency for Toxic Substances & Disease Registry (2014). Medical management guidelines for hydrogen fluoride (HF) CAS ID # 7664-39-3, UN# 1052 (anhydrous), 1790 (solution). Retrieved from https://www.atsdr.cdc.gov/mhmi/mmg11.pdf
216. Agency for Toxic Substances & Disease Registry (2014). Medical management guidelines for methyl isocyanate (C2H3NO) CAS ID# 624-83-9, UN# 2480. Retrieved from https://www.atsdr.cdc.gov/MMG/MMG.asp?id=628&tid=84

217. Browning, J. B. (1993). Union carbide: disaster at bhopal. [Book Author] Jack Gottschalk. Crisis response: Inside stories on managing under siege. Visible Ink Press, a division of Gale Research, Detroit, Michigan. Retrieved from http://www.environmentportal.in/files/report-1.pdf
218. PENTA Consortium, LLC (2019). Harris county multi-agency coordinating group gap analysis. Retrieved from https://www.readyharris.org/Portals/43/PDFs/Harris%20County%20Gap%20Analysis%20Report%20-%20Updated%20and%20optimized.pdf?ver=2019-07-25-155525-513
219. Lester, L. J. & Gonzalez, L. A. (2011). A characterization of the Galveston Bay ecosystem, 3rd edition. Galveston Bay Estuary Program, Texas Commission on Environmental Quality. Retrieved from https://www.researchgate.net/publication/261759345_State_of_the_bay_A_characterization_of_the_Galveston_Bay_ecosystem_Third_Edition
220. Galveston Bay Foundation and Houston Advanced Research Center (2018). Galveston bay report card. Retreived from https://www.harcresearch.org/work/Galveston_Bay_Report_Card
221. Texas Commission on Environmental Quality Chief Engineer's Office (2006). Mercury in Texas: Background, federal rules, control technologies, and fiscal implication - A report to the Texas Legislature. SFR-085. Retrieved from https://www.tceq.texas.gov/assets/public/comm_exec/pubs/sfr/085.pdf
222. National Pesticide Information Center (2000). DDT technical fact sheet. Retrieved from http://npic.orst.edu/factsheets/archive/ddttech.pdf
223. Dianyi, Y. (2014). ATSDR case studies in environmental medicine: Polychlorinated biphenyls (PCBs) toxicity. US Department of Health and Human Services Agency for Toxic Substances and Disease Registry. Retrieved from https://www.atsdr.cdc.gov/csem/pcb/docs/pcb.pdf
224. Texas Commission on Environmental Quality (2019). Surface water quality viewer. Retrieved from https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778
225. Houston Advanced Research Center (2017). Galveston bay status and trends. Retrieved from https://galvbaydata.org/www.galvbaydata.org/SeafoodSafety/tabid/1743/Default.html
226. Wahowiak, L. (2016). Infrastructure, public health linked, crisis in Flint shows: Aging US systems pose risks to health. The Nation's Health, 46(3), 1-15. Retrieved from http://thenationshealth.aphapublications.org/content/46/3/1.3
227. University of Texas Health Science Center at Houston School of Public Health (2010). Health of Houston survey: Indicators. Retrieved from https://hhs2010.sph.uth.tmc.edu/SingleMapReport/
228. Texas Commission on Environmental Quality (2019). Surface water quality viewer. Retrieved from https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778
229. Texas Commission on Environmental Quality (2019). State of Texas public drinking water program 2018 annual compliance report. Retrieved from https://www.tceq.texas.gov/assets/public/permitting/watersupply/pdw/EPA_ACR_2018_FINAL.pdf
230. Environmental Protection Agency (2019). Superfund. Retrieved from https://www.epa.gov/superfund
231. Environmental Protection Agency (2019). The Superfund Program: Protecting healthy communities, advancing environmental protection. Retrieved from https://www.epa.gov/superfund/superfund-program-protecting-healthy-communities-advancing-environmental-protection
232. Environmental Protection Agency (2019). Brownfields. Retrieved from https://www.epa.gov/brownfields.
233. Environmental Protection Agency Facility Registry Service (2018). USEPA facility registry service datasets [Data file]. Environmental Dataset Gateway. Retrieved from https://edg.epa.gov/metadata/catalog/search/resource/details.page?uuid={0fd2712b-62d0-4aaf-ab20-2cbfe8c26b30}
234. Intergovernmental Panel on Climate Change (2007). Climate change 2007: Synthesis report – Summary for policymakers. Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
235. Intergovernmental Panel on Climate Change (2007). Climate change 2007: Synthesis report – Summary for policymakers. Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
236. Intergovernmental Panel on Climate Change (2014). Climate change 2014: Synthesis report. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf
237. Intergovernmental Panel on Climate Change (2014). Climate change 2014: Synthesis report. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf
238. Intergovernmental Panel on Climate Change (2014). Climate change 2014: Synthesis report. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf
239. Needham, H.F. & Keim, B.D. (2011). A storm surge database for the US Gulf Coast. International Journal of Climatology, 32(14), 2108-2123. https://doi.org/10.1002/joc.2425
240. Environmental Protection Agency (2016). What climate change means for Texas. Retrieved from https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-tx.pdf
241. Environmental Protection Agency (2016). What climate change means for Texas. Retrieved from https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-tx.pdf
242. Environmental Protection Agency (2016). What climate change means for Texas. Retrieved from https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-tx.pdf
243. Go Big In Texas (n.d.). Petroleum refining & chemical products. Retrieved from https://businessintexas.com/industries/petroleum-refining-chemical-products
244. Environmental Protection Agency (n.d.). Particulate matter (PM) pollution. Retrieved from https://www.epa.gov/pm-pollution/particulate-matter-pm-ba-

sics
245. Environmental Protection Agency (n.d.). Ground-level ozone pollution. Retrieved from https://www.epa.gov/ground-level-ozone-pollution
246. Cummings, P. L., Schwaller, E., Wesely, S., Choi, L. E.; Shah, U., Becker, L., & Schaffer M. (2016). East Aldine district's town center development: A health impact assessment in Harris County. Harris County Public Health. Retrieved from https://www.pewtrusts.org/-/media/assets/external-sites/health-impact-project/east-aldine-hia.pdf?la=en&hash=0DA58E910BA805DFBD833CCAACDD13DE0481100E
247. Roof, K. & Oleru, N. (2008). Public health: Seattle and King County's push for the built environment. Journal of Environmental Health, 71(1), 24-27. Retrieved from https://pdfs.semanticscholar.org/6315/7a403f36a9c1c40e41f0b27c5a219ebb482c.pdf
248. Design for Health (2017). Integrating health into comprehensive planning. Retrieved from http://designforhealth.net/integrating-health-into-comprehensive-planning/
249. National Academies of Sciences, Engineering, and Medicine (2017). Communities in action: Pathways to health equity. Washington, DC: National Academies Press. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/28418632
250. Design for Health (2017). Integrating health into comprehensive planning. Retrieved from http://designforhealth.net/integrating-health-into-comprehensive-planning/
251. Thornton, C. M., Conway, T. L., Cain, K. L., Gavand, K. A., Saelens, B. E., Frank, L. D., ... et al. (2016). Disparities in pedestrian streetscape environments by income and race/ethnicity. SSM - Population Health, 2, 206-216. https://doi.org/10.1016/j.ssmph.2016.03.004
252. American Association of State Highway and Transportation Officials (2015). Commuting in America 2013: The national report on commuting patterns and trends. Retrieved from https://traveltrends-dev.transportation.org/wp-content/uploads/sites/62/2019/07/ES_Executive-Summary_CAES-4_web.pdf
253. Bell, J. & Cohen, L. (2009). The transportation prescription: Bold new ideas for healthy, equitable transportation reform in America. PolicyLink, Convergence Partnership and Prevention Institute. Retrieved from https://www.preventioninstitute.org/publications/the-transportation-prescription-bold-new-ideas-for-healthy-equitable-transportation-reform-in-america
254. Berke, E. M. & Vernez-Moudon, A. (2014). Built environment change: a framework to support health-enhancing behaviour through environmental policy and health research. Journal of Epidemiology and Community Health, 68(6), 586-590. doi: 10.1136/jech-2012-201417
255. Perdue, W. C., Stone, L. A., & Gostin, L. O. (2003). The built environment and its relationship to the public's health: The legal framework. American Journal of Public Health, 93(9), 1390-1394. doi: 10.2105/ajph.93.9.1390
256. Kent, J. & Thompson, S. (2012). Health and the built environment: Exploring foundations for a new interdisciplinary profession. Journal of Environmental and Public Health. doi: 10.1155/2012/958175
257. Centers for Disease Control and Prevention (2019). Community strategies. Retrieved from https://www.cdc.gov/physicalactivity/community-strategies/index.htm
258. Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., Ramsey, L. T., … et al. (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. Journal of Physical Activity and Health, 3(s1), S55-S76. doi: 10.1123/jpah.3.s1s55
259. Mumford, K. G., Contant, C. K., Weissman, J., Wolf, J., & Glanz, K. (2011). Changes in physical activity and travel behaviors in residents of a mixed-use development. American Journal of Preventive Medicine, 41(5), 504-507. doi: 10.1016/j.amepre.2011.07.016
260. Sarmiento, C. & Roe, M. J. (2014). People-oriented cities: Designing walkable, bikeable neighborhoods. World Resources Institute: Ross Center. Retrieved from http://thecityfix.com/blog/people-oriented-cities-designing-walkable-bikeable-neighborhoods-active-transport-claudio-sarmiento-matthew-roe/
261. Centers for Disease Control and Prevention (2016). Obesity and overweight. National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/fastats/obesity-overweight.htm
262. Centers for Disease Control and Prevention (2017). Exercise or physical activity. National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/fastats/exercise.htm
263. National Institute of Diabetes and Digestive and Kidney Diseases (2015). Health risks of being overweight. Retrieved from https://www.niddk.nih.gov/health-information/weight-management/health-risks-overweight
264. Plotnikoff, R., Fein, A., Milton, L., Prodaniuk, R., & Mayes, V. (2003). Workplace physical activity framework. Alberta Centre for Active Living. Retrieved from http://www.walkbc.ca/sites/default/files/walkbc/Workplace%20Framework%20Alberta%20Centre%20for%20Active%20Living.pdf
265. US Department of Transportation (2004). Sidewalks promote walking. Bureau of Transportation Statistics Issue Brief, 12. Retrieved from https://www.bts.gov/sites/bts.dot.gov/files/legacy/publications/special_reports_and_issue_briefs/issue_briefs/number_12/pdf/entire.pdf
266. Active Living Research (2009). Walking and biking to school, physical activity and health outcomes. Retrieved from http://activelivingresearch.org/files/ALR_Brief_ActiveTransport_0.pdf
267. DiMaggio, C. & Li, G. (2013). Effectiveness of a safe routes to school program in preventing school-aged pedestrian injury. Pediatrics, 131(2), 290-296. doi: 10.1542/peds.2012-2182
268. Mayo Clinic (2018). Exercise and stress: Get moving to manage stress. Retrieved from http://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/exercise-and-stress/art-20044469
269. Larouche, R. (2012).The environmental and population health benefits of active transport: A review. Greenhouse Gases - Emission, Measurement and Management. Retrieved from http://cdn.intechopen.com/pdfs/32358/InTech-The_environmental_and_population_health_benefits_of_active_transport_a_review.pdf

270. US Census Bureau (n.d.). American community survey 5-year estimates (2013-2017) [Data query]. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
271. Begley, D. (2015). Study finds Houston traffic congestion worsening. Houston Chronicle. Retrieved from http://www.houstonchronicle.com/news/transportation/article/Study-finds-Houston-traffic-congestion-worsening-6169389.php
272. Kent, J. & Thompson, S. (2012). Health and the built environment: Exploring foundations for a new interdisciplinary profession. Journal of Environmental and Public Health. doi: 10.1155/2012/958175
273. US Department of Transportation (2012). Health and transportation: A critical intersection. Fast Lane. Retrieved from http://cvta.org/member-news/104-public-news/542-health-and-transportation-a-critical-intersection.html
274. Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003). Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures. Annals of Behavioral Medicine, 25(2), 80-91. doi: 10.1207/S15324796ABM2502_03
275. Sallis, J. F., Saelens, B. E., Frank, L. D., Conway, T. L., Slymen, D. J., Cain, K. L., ... et al. (2009). Neighborhood built environment and income: Examining multiple health outcomes. Social Science & Medicine, 68(7), 1285-1293. doi: 10.1016/j.socscimed.2009.01.017
276. Frank, L. D., Andresen, M. A., & Schmid, T. L. (2004). Obesity relationships with community design, physical activity, and time spent in cars. American Journal of Preventive Medicine, 27(2), 87-96. doi: 10.1016/j.amepre.2004.04.011
277. Jerrett, M., Shankardass, K., Berhane, K., Gauderman, W. J., Kunzli, N., Avol, E., … et al. (2008). Traffic-related air pollution and asthma onset in children: A prospective cohort study with individual exposure measurement. Environmental Health Perspectives, 116(10), 1433-1438. doi: 10.1289/ehp.10968
278. ChangeLabSolutions (2013). Move this way: Making neighborhoods more walkable and bikeable. Retrieved from http://www.changelabsolutions.org/sites/default/files/MoveThisWay_FINAL-20130905.pdf
279. Governors Highway Safety Administration (2017). Pedestrian traffic fatalities by state: 2017 preliminary data [Data report]. Retrieved from https://www.ghsa.org/resources/spotlight-pedestrians18
280. Redmon, R., Gelinne, D., Walton, L., & Miller, J. (2012). Spotlight on pedestrian safety. Federal Highway Administration, 75(4). Retrieved from https://www.fhwa.dot.gov/publications/publicroads/12janfeb/03.cfm
281. Bassett Jr., D. R., Pucher, J., Buehler, R., Thomson, D. L., & Crouter, S.E. (2008). Walking, cycling, and obesity rates in Europe, North America, and Australia. Journal of Physical Activity and Health, 5(6), 795-814. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/19164816
282. Larouche, R. (2012). The environmental and population health benefits of active transport: A review. Greenhouse Gases - Emission, Measurement and Management. Retrieved from http://cdn.intechopen.com/pdfs/32358/InTech-The_environmental_and_population_health_benefits_of_active_transport_a_review.pdf
283. Sarmiento, C. & Roe, M. J. (2014). People-oriented cities: Designing walkable, bikeable neighborhoods. World Resources Institute: Ross Center. Retrieved from http://thecityfix.com/blog/people-oriented-cities-designing-walkable-bikeable-neighborhoods-active-transport-claudio-sarmiento-matthew-roe/
284. Gibbs, K., Slater, S. J., Nicholson, N., Barker, D. C., & Chaloupka, F. J. (2012). Income disparities in street features that encourage walking - A BTG research brief. Bridging the Gap Program. Retrieved from http://www.bridgingthegapresearch.org/_asset/02fpi3/btg_street_walkability_FINAL_03-09-12.pdf
285. Gibbs, K., Slater, S. J., Nicholson, N., Barker, D. C., & Chaloupka, F. J. (2012). Income disparities in street features that encourage walking - A BTG research brief. Bridging the Gap Program. Retrieved from http://www.bridgingthegapresearch.org/_asset/02fpi3/btg_street_walkability_FINAL_03-09-12.pdf
286. Handy, S., Cao, X., & Mokhtarian, P. L. (2006). Self-selection in the relationship between the built environment and walking: Empirical evidence from northern California. Journal of the American Planning Association, 72(1), 55-74. https://doi.org/10.1080/01944360608976724
287. Handy, S., Cao, X., & Mokhtarian, P. L. (2006). Self-selection in the relationship between the built environment and walking: Empirical evidence from northern California. Journal of the American Planning Association, 72(1), 55-74. https://doi.org/10.1080/01944360608976724
288. Cao, X., Mokhtarian, P. L., & Handy, S. L. (2007). Do changes in neighborhood characteristics lead to changes in travel behavior? A structural equations modeling approach. Transportation, 34(5), 535-556. doi: 10.1007/s11116-007-9132-x
289. Greenwald, M. & Boarnet, M. (2001). Built environment as a determinant of walking behavior: Analyzing non-work pedestrian travel in Portland, Oregon. Transportation Research Record: Journal of the Transportation Research Board, 1780, 33-41. https://doi.org/10.3141/1780-05
290. Boarnet, M. G., Greenwald, M., & McMillan, T. E. (2008). Walking, urban design, and health toward a cost-benefit analysis framework. Journal of Planning Education and Research, 27(3), 341-358. https://doi.org/10.1177/0739456X07311073
291. Cao, X., Mokhtarian, P. L., & Handy, S. L. (2009). No particular place to go: An empirical analysis of travel for the sake of travel. Environment and Behavior, 41(2), 233-257. https://doi.org/10.1177/0013916507310318
292. Murakami, E. & Young, J. (1997). Daily travel by persons with low income. US Federal Highway Administration. https://doi.org/10.21949/1404564
293. Frank, L. & Pivo, G. (1995). Impacts of mixed use and density on utilization of three modes of travel: Single-occupant vehicle, transit, and walking. Transportation Research Record: Journal of the Transportation Research Board, 1466, 44-52. Retrieved from http://onlinepubs.trb.org/Onlinepubs/trr/1994/1466/1466-007.pdf
294. Boarnet, M. G., Greenwald, M., & McMillan, T. E. (2008). Walking, urban design, and

health toward a cost-benefit analysis framework. Journal of Planning Education and Research, 27(3), 341-358. https://doi.org/10.1177/0739456X07311073

295. Handy, S., Cao, X., & Mokhtarian, P. L. (2006). Self-selection in the relationship between the built environment and walking: Empirical evidence from northern California. Journal of the American Planning Association, 72(1), 55-74. https://doi.org/10.1080/01944360608976724
296. Chatman, D. G. (2009). Residential choice, the built environment, and nonwork travel: Evidence using new data and methods. Environment and Planning A: Economy and Space, 41(5), 1072-1089. https://doi.org/10.1068/a4114
297. Pinjari, A. R., Bhat, C. R., & Hensher, D. A. (2009). Residential self-selection effects in an activity time-use behavior model. Transportation Research Part B: Methodological, 43(7), 729-748. doi: 10.1016/j.trb.2009.02.002
298. Alfonzo, M. (2015). Making the economic case for more walkability. Urban Land. Retrieved from https://urbanland.uli.org/sustainability/houston-economic-case-walkability/
299. Centers for Disease Control and Prevention (2019). Community strategies. Retrieved from https://www.cdc.gov/physicalactivity/community-strategies/index.htm
300. Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., Ramsey, L. T., … et al. (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. Journal of Physical Activity and Health, 3(s1), S55-S76. doi: 10.1123/jpah.3.s1s55
301. Bracy, N. L., Millstein, R. A., Carlson, J. A., Conway, T. L., Sallis, J. F., Saelens, B. E., ... et al. (2014). Is the Relationship between the built environment and physical activity moderated by perceptions of crime and safety? International Journal of Behavioral Nutrition and Physical Activity, 11(1), 24. doi: 10.1186/1479-5868-11-24
302. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey: Indicators [Data dashboard & maps]. Retrieved from https://hhs2010.sph.uth.tmc.edu/SingleMapReport
303. Reynolds, K. D., Wolch, J., Byrne, J., Chou, C. P., Feng, G., Weaver, S., & Jerrett, M. (2007). Trail characteristics as correlates of urban trail use. American Journal of Health Promotion, 21(4 Suppl), 335-345. doi: 10.4278/0890-1171-21.4s.335
304. Retting, R. (2016). Pedestrian traffic fatalities by state: 2016 preliminary data. Sam Schwartz Transportation Consultants for Governors Highway Safety Association. Retrieved from https://www.ghsa.org/sites/default/files/2017-03/2017ped_FINAL_4.pdf
305. Governors Highway Safety Administration (2017). Pedestrian traffic fatalities by state: 2017 preliminary data [Data report]. Retrieved from https://www.ghsa.org/resources/spotlight-pedestrians18
306. The University of Texas Health Science Center at Houston UTHealth School of Public Health Institute for Health Policy (2019). Health of Houston survey 2017-2018: A brief summary. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/HHS2018%20final%20report_9-6-2019.pdf
307. Wier, M., Weintraub, J., Humphreys, E. H., Seto, E., & Bhatia R. (2009). An area-level model of vehicle-pedestrian injury collisions with implications for land use and transportation planning. Accident Analysis and Prevention, 41(1), 137-145.
308. Lee, C. & Abdel-Aty, M. (2005). Comprehensive analysis of vehicle-pedestrian crashes at intersections in Florida. Accident Analysis and Prevention, 37(4), 775-786. doi: 10.1016/j.aap.2005.03.019
309. Bennet, S. A. & Yiannakoulias, N. (2015). Motor-vehicle collisions involving child pedestrians at intersection and mid-block locations. Accident Analysis & Prevention, 78, 94-103. doi: 10.1016/j.aap.2015.03.001
310. Yiannakoulias, N. & Scott, D. M. (2013). The effects of local and non-local traffic on child pedestrian safety: A spatial displacement of Risk. Social Science & Medicine, 80, 96-104. doi: 10.1016/j.socscimed.2012.12.003
311. Rothman, L., Macarthur, C., To, T., Buliung, R., & Howard, A. (2014). Motor vehicle-pedestrian collisions and walking to school: The role of the built environment. Pediatrics, 133(5), 776-84. doi: 10.1542/peds/2013-2317
312. Chen, L., Chen, C., Ewing, R., McKnight, C. E., Srinivasan, R., & Roe, M. (2013). Safety Countermeasures and Crash Reduction in New York City—Experience and Lessons Learned. Accident Analysis & Prevention, 50, 312-322. doi: 10.1016/j/aap.2012.05.009
313. US Department of Transportation (2017). Proven safety countermeasures. Federal Highway Safety Administration, Office of Safety. Retrieved from https://safety.fhwa.dot.gov/provencountermeasures/
314. Centers for Disease Control and Prevention (2018). What is Safe Routes to School (SRTS)? Office of the Associate Director for Policy and Strategy. Retrieved from https://www.cdc.gov/policy/hst/hi5/saferoutes/index.html
315. Pillai, P., Schultze, A., Rideaux, J., Shah, U. A., & Schaffer, M. (n.d.). Safe crossings project: Galena park. Harris County Public Health. Retrieved from http://publichealth.harriscountytx.gov/Portals/27/Documents/Programs/Built%20Environment/Safe%20Crossings%20Project_Galena%20Park_FINAL%2071119.pdf?ver=2019-08-09-103325-077
316. Environmental Protection Agency (n.d.). What is green infrastructure? Retrieved from https://www.epa.gov/green-infrastructure/what-green-infrastructure
317. Environmental Protection Agency (n.d.). Benefits of green infrastructure. Retrieved from https://www.epa.gov/green-infrastructure/benefits-green-infrastructure
318. US Department of Housing and Urban Development Office of Policy Development and Research (2003). The practice of low impact development. Retrieved from http://www.h-gac.com/low-impact-development/documents/HUD-Low-Impact-Development.pdf
319. Storey, A. L., Blount, J., & Talbott, M. D. (2011). Harris County low impact development & green infrastructure design criteria for storm water management. Retrieved from https://www.hcfcd.org/media/1543/2011-final_lid_gidc.pdf

320. Kriss, J. (2014). What is green building? US Green Building Council. Retrieved from https://www.usgbc.org/articles/what-green-building
321. World Green Building Council (n.d.). About green building: What is green building? Retrieved from https://www.worldgbc.org/what-green-building
322. Environmental Protection Agency (n.d.). Climate change indicators: U.S. greenhouse gas emissions. Retrived from https://www.epa.gov/climate-indicators/climate-change-indicators-us-greenhouse-gas-emissions
323. Green Build Initiative (2014). UN climate change report strengthens case for green building. Retrieved from https://www.thegbi.org/about-gbi/press-room/article/un-climate-change-report-strengthens-case-for-green-building.
324. Harris County Community Services Department (2017). Harris County affordable housing standards: Project standards, design criteria and underwriting guidelines. Retrieved from https://csd.harriscountytx.gov/Documents/Afford_HousingStandards_with_Prop_Standards_revised_011917.pdf
325. Krieger, J. & Higgins, D. L. (2002). Housing and health: Time again for public action. American Journal of Public Health, 92(5), 758-768. doi:10.2105/ajph.92.5.758
326. Centers for Disease Control and Prevention (n.d.). Health problems caused by lead. Retrieved from https://www.cdc.gov/niosh/topics/lead/health.html
327. American Nutrition Association (n.d.). USDA defines food deserts. Retrieved from http://americannutritionassociation.org/newsletter/usda-defines-food-deserts
328. Guide to Community Preventive Services (2014). Promoting good nutrition. Retrieved from https://www.thecommunityguide.org/topic/nutrition
329. Ploeg, M. V. & Rahkovsky, I. (2016). Recent evidence on the effects of food store access on food choice and diet quality. Retrieved from https://www.ers.usda.gov/amber-waves/2016/may/recent-evidence-on-the-effects-of-food-store-access-on-food-choice-and-diet-quality/
330. Moore, L. V., Roux, A. V. D., Nettleton, J. A., & Jacobs, D. R. (2008). Associations of the local food environment with diet quality -- a comparison of assessments based on surveys and geographic information systems: The multi-ethnic study of atherosclerosis. American Journal of Epidemiology, 167(8), 917-924. doi: 10.1093/aje/kwm394
331. Rose, D. & Richards, R. (2004). Food store access and household fruit and vegetable use among participants in the US food stamp program. Public Health Nutrition, 7(8), 1081-1088. doi: 10.1079/PHN2004648
332. Dean, W. R. & Sharkey, J. R. (2011). Rural and urban differences in the associations between characteristics of the community food environment and fruit and vegetable intake. Journal of Nutrition Education and Behavior, 43(6), 426-433. doi: 10.1016/j.jneb.2010.07.001
333. Jack, D., Neckerman, K., Schwartz-Soicher, O., Lovasi, G. S., Quinn, J., Richards, C., … et al. (2013). Socio-economic status, neighborhood food environments and consumption of fruits and vegetables in New York City. Public Health Nutrition, 16(7), 1197-1205. doi: 10.1017/S1368980012005642
334. Ploeg, M. V. & Rahkovsky, I. (2016). Recent evidence on the effects of food store access on food choice and diet quality. Retrieved from https://www.ers.usda.gov/amber-waves/2016/may/recent-evidence-on-the-effects-of-food-store-access-on-food-choice-and-diet-quality/
335. Chen, R., Smyser, M., Chan, N., Ta, M., & Krieger, J. (2015). Changes in awareness and use of calorie information after mandatory menu labeling in restaurants in King County, Washington. American Journal of Public Health, 105(3), 546-53. doi: 10.2105/AJPH.2014.302262
336. Cummings, P. L., Rueras, N., Adams, R., & Kuo, T. (2014). Local-level program planning for health marketing campaigns should be coupled to food environment interventions, as population sodium knowledge and choosing healthy foods remain low in residents of Los Angeles County, California. (Session #304733). American Public Health Association 142nd Annual Meeting and Expo. New Orleans, Louisiana.
337. Just, D. R. & Wansink, B. (2009). Better school meals on a budget: Using behavioral economics and food psychology to improve meal selection. Choices, 24(3), 1-6. Retrieved from https://www.researchgate.net/publication/305219816_Better_school_meals_on_a_budget_Using_behavioral_economics_and_food_psychology_to_improve_meal_selection
338. Kuo, T., Jarosz, C. J., Simon, P., Fielding, J. E. (2009). Menu labeling as a potential strategy for combating the obesity epidemic: A health impact assessment. American Journal of Public Health, 99(9), 1680-1686. doi: 10.2105/AJPH.2008.153023
339. Lando, A. M. and Labiner-Wolfe, J. (2007). Helping consumers make more healthful food choices: Consumer views on modifying food labels and providing point-of-purchase nutrition information at quick-service restaurants. Journal of Nutrition, Education, and Behavior, 39(3), 157-163. doi: 10.1016/j.jneb.2006.12.010
340. Laz, T. H., Rahman, M., Pohlmeier, A. M., & Berenson, A. B. (2015). Level of nutrition knowledge and its association with weight loss behaviors among low-income reproductive-age women. Journal of Community Health, 40(3), 542-548.
341. Piron, J., Smith, L. V., Simon, P., Cummings, P. L., Kuo, T. (2010). Knowledge, attitudes, and potential response to menu labelling in an urban public health clinic population. Public Health Nutrition, 13(4), 550-555. doi: 10.1017/S1368980009991303
342. Siewell, N., Aguirre, S., & Thomas, M. (2015). Building sustainable neighborhoods through community gardens: Enhancing residents' well-being through university - Community engagement initiative. Metropolitan Universities, 26(1), 173-190. Retrieved from http://journals.iupui.edu/index.php/muj/article/view/20994/20421
343. Alaimo, K., Beavers, A. W., Crawford, C., Snyder, E. H., & Litt, J. S. (2016). Amplifying health through community gardens: A framework for advancing multicomponent, behaviorally based neighborhood interventions. Current Environmental Health Report, 3(3), 302-312. doi: 10.1007/s40572-016-0105-0
344. Levkoe, C. Z. & Wakefield, S. (2011). The community food centre: Creating space for a just, sustainable, and healthy food system. Journal of Agri-

culture, Food Systems, and Community Development, 2(1), 249-268.
345. Miller, S.E., Lee, J.S., Berle, D. (2012). Community engagement from the ground up: An interdisciplinary service learning after-school garden program. Journal of Agriculture, Food Systems, and Community Development, 2(3):121–135. https://doi.org/10.5304/jafscd.2011.021.012
346. Witzling, L., Wander, M., & Phillips, E. (2011). Testing and educating on urban soil lead: A case of Chicago community gardens. Journal of Agriculture, Food Systems, and Community Development, 1(2), 167–185. https://doi.org/10.5304/jafscd.2010.012.015
347. National Recreation and Park Association (n.d.). Parks & recreation in underserved areas: A public health perspective. Retrieved from https://www.nrpa.org/uploadedFiles/nrpa.org/Publications_and_Research/Research/Papers/Parks-Rec-Underserved-Areas.pdf
348. Centers for Disease Control and Prevention (2013). Parks and trails health impact assessment toolkit. Retrieved from https://www.cdc.gov/healthyplaces/parks_trails/
349. Kaczynski, A.T. & Henderson, K.A. (2007). Environmental correlates of physical activity: A review of evidence about parks and recreation. Leisure Sciences, 29(4), 315-354. doi: 10.1080/01490400701394865
350. University of California, Berkeley School of Public Health (2011). Parks and recreation programs help to reduce childhood obesity. Retrieved from https://activelivingresearch.org/sites/activelivingresearch.org/files/PolicyBrief_ParkProximity_0.pdf
351. National Recreation and Parks Association (n.d.). Parks and improved mental health and quality of life. Retrieved from http://www.nrpa.org/our-work/three-pillars/health-wellness/parksandhealth/fact-sheets/parks-improved-mental-health-quality-life/
352. Sturm, R. & Cohen, D. (2014). Proximity to urban parks and mental health. The Journal of Mental Health Policy and Economics, 17(1), 19–24. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4049158/
353. Kaplan, S. (1995). The restorative benefits of nature: Towards an integrative framework. Journal of Environmental Psychology, 15(3), 169-182. doi: 10.1016/0272-4944(95)90001-2
354. Lohr, V. I., Pearson-Mims, C. H., & Goodwin, G. K. (1995). Interior plants may improve worker productivity and reduce stress in a windowless environment. Journal of Environmental Horticulture, 14, 97-100. Retrieved from https://www.researchgate.net/publication/237441131_Interior_plants_may_improve_worker_productivity_and_reduce_stress_in_a_windowless_environment
355. Kaplan, R. (1993). The role of nature in the context of the workplace. Landscape and Urban Planning, 26(1-4), 193-201. https://doi.org/10.1016/0169-2046(93)90016-7
356. Heerwagen, J. H. & Orians, G. H. (2002). The ecological world of children. In Kahn Jr., P. H. J. & Kellert, S. R. (eds.), Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations. MIT Press, Cambridge MA, pp. 29-64.
357. Kahn Jr., P. H. J. & Kellert, S. R. (2002). Children and nature: psychological, sociocultural, and evolutionary investigations. MIT Press, Cambridge MA, pp. 29-64.
358. Sayers, J. (2001). The world health report 2001 – Mental health: New understanding, new hope. Bulletin of the World Health organization, 79(11), 1085. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2566704/
359. US Department of Health and Human Services (1999). Mental health: a report of the Surgeon General. Pittsburgh, PA: Superintendent of Documents. Retrieved from https://www.loc.gov/item/2002495357/
360. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
361. US Census Bureau (n.d.). American community survey 5-year estimates (2013-2017) [Data query]. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
362. Kamal, R. (2017). What are the current costs and outcomes related to mental health and substance use disorders? Kaiser Family Foundation. Retrieved from https://www.healthsystemtracker.org/chart-collection/current-costs-outcomes-related-mental-health-substance-abuse-disorders/#item-start
363. Pharmaceutical Research and Manufacturers of America (2014). Medicines in development for mental health. Retrieved from http://phrma-docs.phrma.org/sites/default/files/pdf/2014-mental-health-report.pdf
364. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
365. The Harris Center for Mental Health and IDD (n.d.). Adult outpatient mental health services. Retrieved from https://www.theharriscenter.org/Portals/0/Service%20Page%20Docs/Outpatient%20Mental%20Health%20Services/11-12-18__Adult%20MH.pdf
366. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
367. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
368. Buettgens, M., Blumberg, L., & Pan, C. (2018). Characteristics of the uninsured in Texas, 2018; Spotlight: Harris County (Houston). Urban Institute. Retrieved from https://www.urban.org/sites/default/files/harris_county_characteristics_of_the_uninsured_in_texas_factsheet.pdf
369. US Preventive Services Task Force (2016). Final recommendation statement; Depression in adults: Screening. Retrieved from https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/depression-in-adults-screening1
370. Begley, C., Hamilton, J., & Shin J. (2015). Harris County emergency department use study: 2012-2013 all hospitals report. Retrieved from https://sph.uth.edu/research/centers/chsr/assets/Harris%20County%20ED%20Use%20Study%20

(2012-2013%20All%20Hospitals%20Report).pdf
371. World Health Organization (2001). Mental health: A call for action by world health ministers. Ministerial Round Tables: 54th World Health Assembly. Retrieved from https://www.who.int/mental_health/advocacy/en/Call_for_Action_MoH_Intro.pdf
372. National Institute on Drug Abuse (2019). Overdose death rates. National Institutes of Health. Retrieved from https://www.drugabuse.gov/related-topics/trends-statistics/overdose-death-rates
373. National Institute on Drug Abuse (2019). Texas opioid summary. National Institutes of Health. Retrieved from https://www.drugabuse.gov/opioid-summaries-by-state/texas-opioid-summary#targetText=Texas%20continues%20to%20have%20one,14.6%20deaths%20per%20100%2C000%20persons.
374. Centers for Disease Control and Prevention (2018). Suicide mortality in the United States, 1999-2017 [PDF report]. NCHS Data Brief, 330. Retrieved from https://www.cdc.gov/nchs/products/databriefs/db330.htm
375. Texas Department of State Health Services (2017) Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
376. Harris County Psychiatric Center. (n.d.) Public mental health system in Harris County. Retrieved from https://hcpc.uth.edu/pages/public-mental-health/
377. Gerrity, M., Zoller, E., Pinson, N., Pettinari, C., & King, V. (2014). Integrating primary care into behavioral health settings: What works for individuals with serious mental illness. New York, NY: Milbank Memorial Fund. Retrieved from https://www.integration.samhsa.gov/integrated-care-models/Integrating-Primary-Care-Report.pdf
378. Fortney, J. C., Pyne, J. M., Turner, E. E., Farris, K. M., Normoyle, T. M., Avery, M. D., Hilty, D. M., & Unutzer, J. (2015) Telepsychiatry integration of mental health services into rural primary care settings. International Review of Psychiatry, 27(6), 525-539.
379. Meadows Mental Health Policy Institute (2017). Harris County mental health services for children, youth, and families: 2017 system assessment. Houston Endowment. Retrieved from https://www.houstonendowment.org/wp-content/uploads/Harris-County-Mental-Health-Services-for-Children-2017-Assessment-embargoed.pdf
380. Harris County Sheriff's Office (n.d.). Jail mental health initiatives. Retrieved from https://www.harriscountycit.org/jail-mental-health-unit
381. Blakinger, K. (2017). Lack of beds for inmates needing mental health help. Houston Chronicle. Retrieved from https://www.houstonchronicle.com/news/article/Lack-of-beds-for-inmates-needing-mental-health-12268349.php
382. Texas Medical Center Health Policy Institute (2017). TMC-72 Response psychiatric beds HCPHC. Retrieved from https://www.tmc.edu/health-policy/wp-content/uploads/sites/5/2017/02/024-TMC72-Response-Psychiatric-Beds-HCPC.pdf
383. Hellebuyck, M., Halpern, M., Nguyen, T., & Fritze, D. (2018). The state of mental health in America. Mental Health America. Retrieved from https://www.mhanational.org/sites/default/files/2019%20MH%20in%20America%20Final_0.pdf
384. Begley, C., Hall, J., Shenoy, A. G., Hanke, J., Wells, R., & Revere, L. (2016). Design and implementation of the Texas Medicaid DSRIP program. Population Health Management, 20(2). doi: 10.1089/pop.2015.0192.
385. Menninger Clinic (2016). Community health needs assessment. Retrieved from https://www.menningerclinic.org/Assets/menninger-chna-final-report-6-30-16.pdf
386. Texas Health and Human Services (n.d.). Adult mental health case management. Retrieved from https://hhs.texas.gov/services/mental-health-substance-use/adult-mental-health/adult-mental-health-case-management
387. Bakerjian, D. (2014). Pets impact on quality of life, a case study. Geriatric Nursing, 35(2), 160–163. doi: 10.1016/j.gerinurse.2014.02.009
388. Power, E. R. (2015). Dogs and practices of community and neighboring. Anthrozoös, 26(4), 579–91. https://doi.org/10.2752/175303713X13795775536011
389. Myers, O. E. G. (2003). No longer the lonely species: A post-mead perspective on animals and sociology. International Journal of Sociology and Social Policy, 23(3), 46–68. doi: 10.1108/01443330310790255
390. Brooks, H. L., Rushton, K., Lovell, K., Bee, P., Walker, L., Grant, L., & Rogers, A. (2018). The power of support from companion animals for people living with mental health problems: a systematic review and narrative synthesis of the evidence. BMC Psychiatry, 18(31). doi: 10.1186/s12888-018-1613-2
391. National Center for Injury Prevention and Control (2019). Adverse childhood experiences. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/index.html
392. Office of the Superintendent of Public Instruction (2010). Washington state early learning plan. Retrieved from www.k12.wa.us/EarlyLearning/pubdocs/ WashingtonEarlyLearningPlan.pdf
393. Rice University Children's Environmental Health Initiative (2019). Hurricane Harvey registry initial report. Retrieved from https://cehi.rice.edu/sites/g/files/bxs176/f/u14/KI%20Research%20Report%E2%80%93Hurricane%20Harvey%20Registry%208.pdf
394. Menninger Clinic (n.d.). BridgeUp at Menninger. Retrieved from https://www.menningerclinic.org/donate/funding-priorities/bridgeup-at-menninger
395. Office of Disease Prevention and Health Promotion (2019). Mental health and health disorders. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/mental-health-and-mental-disorders
396. Los Angeles County Department of Mental Health (2019). Underserved cultural communities (USCC). Retrieved from https://dmh.lacounty.gov/about/mhsa/uscc/
397. Los Angeles County Department of Mental Health (n.d.). UsCC subcommittees fact sheet. Retrieved from http://file.lacounty.gov/SDSInter/dmh/1052191_DidYouKnowFactSheet-UsCC.

pdf
398. World Health Organization (2018). Non Communicable Diseases. Retrieved from https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
399. GBD 2015 Obesity Collaborators (2017). Health effects of overweight and obesity in 195 countries over 25 years. New England Journal of Medicine, 377(1), 13-27.
400. Centers for Disease Control and Prevention (2019). About chronic disease. National Center for Chronic Disease Prevention and Health Promotion. Retrieved from https://www.cdc.gov/chronicdisease/index.htm
401. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
402. American Public Health Association (n.d.). Public health and chronic disease: Cost savings and return on investment. Retrieved from https://www.apha.org/~/media/files/pdf/factsheets/chronicdiseasefact_final.ashx
403. Price, J. H., Khubchandani, J., McKinney, M., & Braun, R. (2013). Racial/ethnic disparities in chronic diseases of youths and access to health care in the US. BioMed Research International, 787616. doi:10.1155/2013/787616
404. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
405. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
406. Pugil, J. & McArthur, K. (2015). Providing health care to those in need: Community health clinics in Harris County. Retrieved from https://www.episcopalhealth.org/files/4314/7740/6143/HHFC_2015_Report-102316-web.pdf
407. Texas Department of State Health Services (2015). Deaths from 39 selected causes by public health region and county of residence [Excel data file]. Retrieved from https://dshs.texas.gov/chs/vstat/vs15/23.xlsx.
408. Houston State of Health (2019). Age-adjusted death rate due to heart disease. Retrieved from http://www.houstonstateofhealth.com/indicators/index/view?indicatorId=105&localeId=2675
409. Centers for Disease Control and Prevention (2017). Stats of the state of Texas. National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/pressroom/states/texas/texas.htm
410. Centers for Disease Control and Prevention (2017). Heart disease facts. Retrieved from https://www.cdc.gov/heartdisease/facts.htm
411. Centers for Disease Control and Prevention (2017). Heart disease fact sheet. National Center for Health Statistics, Division for Heart Disease and Stroke Prevention. Retrieved from https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm
412. National Center for Complementary and Integrative Health (2017). Cardiovascular disease. National Institute of Health. Retrieved from https://nccih.nih.gov/health/heart-disease
413. Mozaffarian D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman M., … et al. (2016). Heart disease and stroke statistics - 2016 Update: A report from the American Heart Association. Circulation, 133(4), e38-e360. doi: 10.1161/CIR.0000000000000350
414. Office of Disease Prevention and Health Promotion (2019). Heart disease stroke. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/heart-disease-and-stroke
415. Office of Disease Prevention and Health Promotion (2019). Heart disease stroke. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/heart-disease-and-stroke
416. Yoon, S. S., Fryar, C. D., & Carroll, M. D. (2015). Hypertension prevalence and control among adults: US, 2011-2014. NCHS Data Brief, 220, 1-8. Retrieved from https://www.cdc.gov/nchs/data/databriefs/db220.pdf
417. Institute of Medicine of the National Academies (2005). Dietary reference intakes for water, potassium, sodium, chloride, and sulfate. Washington DC: National Academies Press, 21-618.
418. Jackson S. L., King S. M., Zhao L., & Cogswell M. E. (2016). Prevalence of excess sodium intake in the US - NHANES, 2009-2012. Morbidity and Mortality Weekly Report, 64(52), 1393-1397. doi: 10.15585/mmwr.mm6452a1
419. Havranek, E. P., Mujahid, M. S., Barr, D. A., Blair, I. V., Cohen, M. S., Cruz-Flores, S., … et al. (2015). Social determinants of risk and outcomes for cardiovascular disease: A scientific statement from the American Heart Association. Circulation, 132(9), 873-898. doi: 10.1161/CIR.0000000000000228
420. Barr, D. A. (2016). Geography as disparity: The shifting burden of Heart Disease. Circulation, 133(12), 1151-1154. doi: 10.1161/CIRCULATIONAHA.116.021764
421. American Heart Association (2018). Coronary artery disease - Coronary heart disease. Retrieved from https://www.heart.org/HEARTORG/Conditions/More/MyHeartandStrokeNews/Coronary-Artery-Disease-%13The-ABCs-of-CAD_UCM_436416_Article.jsp
422. Illinois Heart Disease and Stroke Prevention Program (n.d.). Cardiovascular disease risk factors. Retrieved from http://www.idph.state.il.us/heartstroke/cvd_rf.htm
423. Office of Disease Prevention and Health Promotion (2019). Heart disease and stroke. HealthPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/heart-disease-and-stroke
424. Nazir, M. A. (2017). Prevalence of periodontal disease, its association with systemic diseases and prevention. International Journal of Health Sciences, 11(2), 72.
425. Havranek, E. P., Mujahid, M. S., Barr, D. A., Blair, I. V., Cohen, M. S., Cruz-Flores, S., … et al. (2015). Social determinants of risk and outcomes for cardiovascular disease: A scientific statement from the American Heart Association. Circulation, 132(9), 873-898. doi: 10.1161/CIR.0000000000000228
426. Barr, D. A. (2016). Geography as disparity: The shifting burden of Heart Disease. Circulation, 133(12), 1151-1154. doi: 10.1161/CIRCULATIONAHA.116.021764

427. Ferdinand, K. C., Yadav, K., Nasser, S. A., Clayton Jeter, H. D., Lewin, J., Cryer, D. R., & Senatore, F. F. (2017). Disparities in hypertension and cardiovascular disease in blacks: The critical role of medication adherence. Journal of Clinical Hypertension, 19(10), 1015-1024. doi:10.1111/jch.13089
428. Weatherspoon, D. J., Borrell, L. N., Johnson, C. W., Mujahid, M. S., Neighbors H. W., & Adar, S. D. (2016). Racial and ethnic differences in self-reported periodontal disease in the multi-ethnic study of atherosclerosis (MESA). Oral Health and Preventive Dentistry, 14(3), 249-257. doi: 10.3290/j.ohpd.a35614
429. British Heart Foundation (n.d.). Misdiagnosis of heart attacks in women. Retrieved from https://www.bhf.org.uk/informationsupport/heart-matters-magazine/medical/women/misdiagnosis-of-heart-attacks-in-women
430. Maserejian, N. N., Link, C. L., Lutfey, K. L., Marceau, L. D., & McKinlay, J. B. (2009). Disparities in physicians' interpretations of heart disease symptoms by patient gender: Results of a video vignette factorial experiment. Journal of Women's Health, 18(10), 1661–1667. doi: 10.1089/jwh.2008.1007
431. Zerwic, J. J., Ryan, C. J., DeVon, H. A., & Drell, M. J. (2003). Treatment seeking for acute myocardial infarction symptoms: Differences in delay across sex and race. Nursing Research, 52(3), 159-167. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/12792256
432. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
433. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
434. Texas Department of State Health Services (2017) Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
435. Texas Department of State Health Services (2017) Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
436. Texas Department of State Health Services (2017) Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
437. Kramer, C. K., Mehmood, S., & Suen, R. S. (2019). Dog ownership and survival: A systematic review and meta-analysis. Circulation, 12(10), e005554-e005554. doi: 10.1161/CIRCOUTCOMES.119.005554
438. Mubanga, M., Byberg, L., Egenvall, A., Ingelsson, E., & Fall, T. (2019). Dog ownership and survival after a major cardiovascular event: A register-based prospective study, Circulation, 12(10), e005342. doi: 10.1161/CIRCOUTCOMES.118.005342
439. Levine, G. N., Allen, K., Braun, L. T., Christian, H. E., Friedmann, E., Taubert, S. A., et al. (2013). Pet ownership and cardiovascular risk: A scientific statement from the American Heart Association. Circulation, 127(23), 2353-2363. doi: 10.1161/CIR.0b013e31829201e1
440. Office of Disease Prevention and Health Promotion (2019). Diabetes. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/diabetes#6
441. Centers for Disease Control and Prevention (2018). Stats of the state of Texas [2017 data tables]. National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/pressroom/states/texas/texas.htm
442. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
443. American Diabetes Association and National Institute of Diabetes, Digestive and Kidney Diseases (2002). The prevention or delay of type 2 diabetes. Diabetes Care, 25(4), 742-749. doi: 10.2337/diacare.25.4.742
444. Houston Health Department (n.d.). Diabetes awareness and wellness network (DAWN). Retrieved from http://www.houstontx.gov/health/Community/dawn/index.html
445. Diabetes Awareness and Wellness Network (DAWN) Center. (n.d.). Diabetes: Prevention, control, management. Retrieved from http://houstontx.gov/health/Community/dawn/documents/diabetes_partners.pdf
446. Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of obesity among adults and youth: US, 2015–2016. NCHS Data Brief, 288, 1-8. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/29155689
447. Hruby, A. & Hu, F. B. (2015). The epidemiology of obesity: A big picture. Pharmacoeconomics, 33(7), 673-689. doi: 10.1007/s40273-014-0243-x
448. Pi-Sunyer, X. (2009). The medical risks of obesity. Postgraduate Medicine, 121(6), 21-33. doi: 10.3810/pgm.2009.11.2074
449. Centers for Disease Control and Prevention (2017). Adult obesity causes & consequences. Retrieved from https://www.cdc.gov/obesity/adult/causes.html
450. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
451. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston 2018 [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/
452. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey: Indicators [Data dashboard & maps]. Retrieved from https://hhs2010.sph.uth.tmc.edu/SingleMapReport
453. Texas Education Agency (n.d.). Fitness data [Data file]. Retrieved from https://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data
454. Heron, M. P. (2018). Deaths: Leading causes for

2016. National Vital Statistics Reports, 67(6). Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr67/nvsr67_06.pdf
455. National Cancer Institute (2019). Common cancer types. Retrieved from https://www.cancer.gov/types/common-cancers
456. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
457. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
458. Centers for Disease Control and Prevention (2018). Leading cancer cases and deaths, male and female, 2016. US Cancer Statistics: Data Visualizations. Retrieved from https://gis.cdc.gov/Cancer/USCS/DataViz.html
459. Tabár, L., Dean, P. B., Chen, T. H. H., Yen, A. M. F., Chen, S. L. S., Fann, J. C. Y., ... et al. (2019). The incidence of fatal breast cancer measures the increased effectiveness of therapy in women participating in mammography screening. Cancer, 125(4), 515-523. doi: 10.1002/cncr.31840
460. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
461. Cancer Prevention & Research Institute of Texas (2018). 2018 Texas cancer plan: A statewide call to action for cancer research, prevention, and control. Retrieved from https://www.acco.org/wp-content/uploads/2017/04/texas_ccc_plan.pdf
462. Texas Department of State Health Services (2017). Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
463. Siegel, R. L., Miller, K. D., & Jemal, A. (2019). Cancer statistics, 2019. CA: A Cancer Journal For Clinicians, 69(1), 7-34. doi: 10.3322/caac.21551
464. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
465. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
466. Texas Department of State Health Services (2019). Cancers associated with modifiable risk factors. Retrieved from https://www.dshs.state.tx.us/tcr/data/modifiable-risk-factors.aspx
467. World Health Organization (2019). Cancer. Retrieved from https://www.who.int/health-topics/cancer#tab=overview
468. Texas Department of State Health Services (2019). Cancers associated with modifiable risk factors. Retrieved from https://www.dshs.state.tx.us/tcr/data/modifiable-risk-factors.aspx
469. Texas Department of State Health Services (2019). HPV-associated cancers. Texas Health and Human Services. Retrieved from https://www.dshs.state.tx.us/tcr/data/hpv-associated-cancers.aspx
470. Centers for Disease Control and Prevention (2019). Cervical cancer is preventable. Retrieved on Oct 2019 from https://www.cdc.gov/vitalsigns/cervical-cancer/index.html
471. Centers for Disease Control and Prevention (2019). 6 types of cancer caused by HPV. Retrieved from https://www.cdc.gov/hpv/parents/cancer.html
472. Texas Department of State Health Services (2017). 2017 national immunization survey - Teen: Texas perspective. Texas Health and Human Services. Retrieved from https://www.dshs.texas.gov/immunize/coverage/pdf/2017_NIS_Teen_Full_Report/
473. American Cancer Society (2019). Cancer facts & figures. Retrieved from https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2019/cancer-facts-and-figures-2019.pdf
474. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey: Indicators [Data dashboard & maps]. Retrieved from https://hhs2010.sph.uth.tmc.edu/SingleMapReport
475. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
476. Simmons, S. (2019). Facts & figures 2019: US cancer death rate has dropped 27% in 25 years. American Cancer Society. Retrieved from https://www.cancer.org/latest-news/facts-and-figures-2019.html
477. Siteman Cancer Center (n.d.). Prevention health disparities. Retrieved from https://siteman.wustl.edu/prevention/health-disparities/
478. Ma, J., Jemal, A., Fedewa, S., Islami, F., Lichtenfeld, J. L., Wender, R. C., … et al. (2019). The American Cancer Society 2035 challenge goal on cancer mortality reduction. CA: A Cancer Journal For Clinicians, 69(5), 1-12. https://doi.org/10.3322/caac.21564
479. American Cancer Society (2016). Cancer treatment & survivorship: Facts & figures 2016-2017. Retrieved from https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/cancer-treatment-and-survivorship-facts-and-figures/cancer-treatment-and-survivorship-facts-and-figures-2016-2017.pdf
480. White, M. C., Hayes, N. S., & Richardson, L. C. (2015). Public health's future role in cancer survivorship. American Journal of Preventive Medicine, 49(6), S550-S553. doi: 10.1016/j.amepre.2015.08.023
481. Texas Comptroller of Public Accounts (2019). Underage smoking provisions: Regulatory information. Retrieved from https://comptroller.texas.gov/taxes/tobacco/regulatory.php
482. 211 LA County. How to use sunscreens correctly (Hint, you probably aren't!). Retrieved from https://www.211la.org/how-use-sunscreens-correctly-hint-you-probably-aren't
483. Hebert, L. E., Weuve, J., Scherr, P. A., & Evans, D. A. (2013). Alzheimer disease in the US

(2010–2050) estimated using the 2010 census. Neurology, 80(19), 1778- 1783. doi: 10.1212/WNL.0b013e31828726f5

484. Brodaty, H., & Donkin, M. (2009). Family caregivers of people with dementia. Dialogues in Clinical Neuroscience, 11(2), 217. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3181916/
485. Hebert, L. E., Weuve, J., Scherr, P. A., & Evans, D. A. (2013). Alzheimer disease in the US (2010–2050) estimated using the 2010 census. Neurology, 80(19), 1778- 1783. doi: 10.1212/WNL.0b013e31828726f5
486. World Health Organization (2019). Dementia. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dementia
487. Matthews, K. A., Xu, W., Gaglioti, A. H., Holt, J. B., Croft, J. B., Mack, D., & McGuire, L. C. (2019). Racial and ethnic estimates of Alzheimer's disease and related dementias in the US (2015–2060) in adults aged ≥ 65 years. Alzheimer's & Dementia, 15(1), 17-24. doi: 10.1016/j.jalz.2018.06.3063
488. Alzheimer's Association (2018). Alzheimer's statistics: Texas. Retrieved from https://www.alz.org/media/Documents/texas-alzheimers-facts-figures-2018.pdf
489. Centers for Disease Control and Prevention (2019). What is dementia? Retrieved from https://www.cdc.gov/aging/dementia/index.html
490. Alzheimer's Association (n.d.). Younger/early onset Alzheimer's. Retrieved from https://www.alz.org/alzheimers-dementia/what-is-alzheimers/younger-early-onset
491. Edwards III, G. A., Gamez, N., Escobedo Jr., G., Calderon, O., & Moreno-Gonzalez, I. (2019). Modifiable risk factors for Alzheimer's disease. Frontiers in Aging Neuroscience, 11, 146. doi: 10.3389/fnagi.2019.00146
492. Kamer, A. R., Craig, R. G., Dasanayake, A. P., Brys, M., Glodzik-Sobanska, L., & de Leon, M. J. (2008). Inflammation and Alzheimer's disease: Possible role of periodontal diseases. Alzheimer's & Dementia, 4(4), 242-250. doi: 10.1016/j.jalz.2007.08.004
493. Singhrao, S. K., & Olsen, I. (2019). Assessing the role of Porphyromonas gingivalis in periodontitis to determine a causative relationship with Alzheimer's disease. Journal of Oral Microbiology, 11(1), 1563405. doi: 10.1080/20002297.2018.1563405
494. Centers for Disease Control and Prevention (2019). What is dementia? Retrieved from https://www.cdc.gov/aging/dementia/index.html
495. Alzheimer's Association (2019). 2019 Alzheimer's disease facts and figures. Alzheimer's and Dementia, 15(3), 321-387. Retrieved from https://www.alz.org/media/documents/alzheimers-facts-and-figures-2019-r.pdf
496. World Health Organization (2019). Dementia. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dementia
497. World Health Organization (2019). Dementia. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dementia
498. World Health Organization (2019). Dementia. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dementia
499. Alzheimer's Association (n.d). Causes and risk factors. Retrieved from https://www.alz.org/alzheimers-dementia/what-is-alzheimers/causes-and-risk-factors
500. Alzheimer's Association (2018). Alzheimer's statistics: Texas. Retrieved from https://www.alz.org/media/Documents/texas-alzheimers-facts-figures-2018.pdf
501. Lam, P., Brown, L., & Hughes, R. (2019). How does tai chi for memory work? Tai Chi for Health Institute. Retrieved from https://taichiforhealthinstitute.org/how-does-tai-chi-for-memory-work/
502. Tri-County Health Department (n.d.). Healthy aging. Retrieved from https://www.tchd.org/283/Healthy-Aging
503. Loftus, P. A. & Wise, S. K. (2016). Epidemiology of asthma. Current Opinion in Otolaryngology & Head and Neck Surgery, 24(3), 245-249. doi: 10.1097/MOO.0000000000000262
504. Centers for Disease Control and Prevention (2019). Asthma: Most recent state or territory asthma data. Retrieved from https://www.cdc.gov/asthma/most_recent_data_states.htm
505. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
506. COPD Foundation (n.d.). About COPD. Retrieved from https://www.copdfoundation.org/
507. Forno, E. & Celedón, J. C. (2012). Health disparities in asthma. American Journal of Respiratory and Critical Care Medicine, 185(10), 1033-1035. doi: 10.1164/rccm.201202-0350ED
508. Guarascio, A. J., Ray, S. M., Finch, C. K., & Self, T. H. (2013). The clinical and economic burden of chronic obstructive pulmonary disease in the USA. ClinicoEconomics and Outcomes Research, 5, 235-245. doi:10.2147/CEOR.S34321
509. Texas Department of State Health Services (2017). Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
510. World Health Organization (2007). Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach. Geneva, Switzerland: World Health Organization, 37-55.
511. Hayden, L. P., Hobbs, B. D., Cohen, R. T., Wise, R. A., Checkley, W., Crapo, J. D., … et al. (2015). Childhood pneumonia increases risk for chronic obstructive pulmonary disease: the COPDGene study. Respiratory Research, 16(1), 115. doi: 10.1186/s12931-015-0273-8
512. Cukic, V., Lovre, V., Dragisic, D., & Ustamujic, A. (2012). Asthma and chronic obstructive pulmonary disease (COPD) - Differences and similarities. Materia Socio-Medica. 24(2), 100–105. doi: 10.5455/msm.2012.24.100-105
513. Centers for Disease Control and Prevention (2019). CDC, States update number of cases of lung disease associated with e-cigarette use, or vaping. CDC Newsroom. Retrieved from https://www.cdc.gov/media/releases/2019/s0912-update-cases-vaping.html
514. Centers for Disease Control and Prevention (2019). Outbreak of lung injury associated with e-cigarette use, or vaping. Retrieved from https://www.

cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html
515. Yelin, E., Trupin, L., Cisternas, M., Eisner, M., Katz, P., & Blanc, P. (2002). A national study of medical care expenditures for respiratory conditions. European Respiratory Journal, 19(3), 414-421. doi:10.1183/09031936.02.00522001
516. Air Alliance Houston (2019). Clean air, Healthy future. Retrieved from https://airalliancehouston.org/
517. American Lung Association (n.d.). Most polluted cities. Retrieved from https://www.lung.org/our-initiatives/healthy-air/sota/city-rankings/most-polluted-cities.html
518. Turcotte, D. A., Alker, H., Chaves, E., Gore, R., & Woskie, S. (2014). Healthy homes: In-home environmental asthma intervention in a diverse urban community. American Journal of Public Health, 104(4), 665-671. doi: 10.2105/AJPH/2013.301695
519. Air Alliance Houston (2019). Clean air, Healthy future. Retrieved from https://airalliancehouston.org/
520. NYC Health (n.d.). NYC asthma partnership. Retrieved from https://www1.nyc.gov/site/doh/providers/health-topics/asthma-provider-partners.page
521. Centers for Disease Control and Prevention (2019). Facts about older adult oral health. Retrieved from https://www.cdc.gov/oralhealth/basics/adult-oral-health/adult_older.htm
522. Campaign for Dental Health (n.d.). Is fluoridation expensive? Retrieved from https://ilikemyteeth.org/fluoridation/cost-of-fluoride/
523. Pew Charitable Trusts (2012). More Americans turning to costly hospital care for preventable dental problems. Retrieved from https://www.pewtrusts.org/en/about/news-room/press-releases-and-statements/0001/01/01/more-americans-turning-to-costly-hospital-care-for-preventable-dental-problems
524. Children's Dental Health Project (2019). Early tooth decay has tremendous human and economic costs. Retrieved from http://www.endcavities.org/at-stake/
525. World Health Organization (n.d.). Injuries. Retrieved from https://www.who.int/topics/injuries/en/
526. Centers for Disease Control and Prevention (2019). WISQARS fatal injury data [Data report]. National Center for Injury Prevention and Control. Retrieved from https://www.cdc.gov/injury/wisqars/fatal.html
527. Centers for Disease Control and Prevention (2019). WISQARS nonfatal injury data [Data report]. National Center for Injury Prevention and Control. Retrieved from https://www.cdc.gov/injury/wisqars/fatal.html
528. Centers for Disease Control and Prevention (2016). Cost of injury. Retrieved from https://www.cdc.gov/injury/wisqars/overview/cost_of_injury.html
529. Centers for Disease Control and Prevention (2016). Cost of Injury. National Center for Injury Prevention and Control. Retrieved from https://www.cdc.gov/injury/wisqars/overview/cost_of_injury.html#targetText=Cost%20of%20Injuries%20and%20Violence%20in%20the%20United%20States&targetText=The%20total%20lifetime%20medical%20and,accounted%20for%20over%20%24457%20billion.
530. Florence, C., Simon, T., Haegerich, T., Luo, F., & Zhou, C. (2015). Estimated lifetime medical and work-loss costs of fatal injuries – United States, 2013. Morbidity and Mortality Weekly Report, 64(38), 1074-1077. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm
531. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
532. Texas Department of State Health Services (2019). Health facts profiles: Texas, 2014 [Selected data table]. Center for Health Statistics. Retrieved from http://healthdata.dshs.texas.gov/HealthFactsProfiles_14_15
533. Centers for Disease Control and Prevention (2017). Cost of injury data. CDC WISQARS. Retrieved from https://www.cdc.gov/injury/wisqars/cost/index.html
534. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
535. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
536. Centers for Disease Control and Prevention (2019). Violence prevention: Risk and protective factors. Retrieved from https://www.cdc.gov/violenceprevention/youthviolence/riskprotectivefactors.html
537. American Psychological Association (2013). Gun violence: Prediction, prevention, and policy. Retrieved from https://www.apa.org/pubs/info/reports/gun-violence-prevention
538. RAND Corporation (2018). Mass shootings: Definitions and trends. Retrieved from https://www.rand.org/research/gun-policy/analysis/essays/mass-shootings.html
539. Gun Violence Archive (2019). Mass shootings in 2019. Retrieved from https://www.gunviolencearchive.org/reports/mass-shooting
540. Harris County Department of Education (n.d.). Safe and secure schools. Retrieved from https://hcde-texas.org/safe-and-secure-schools/
541. McGovern Center for Humanities & Ethics (n.d.). Gun violence & physicians. UTHealth University of Texas Health Science Center at Houston McGovern Medical School. Retrieved from https://med.uth.edu/mcgovern/teaching/bluebook-electives/gun-violence-physicians/
542. Centers for Disease Control and Prevention (2019). Suicide fast facts. Retrieved from https://www.cdc.gov/violenceprevention/suicide/fastfact.html
543. Mayo Clinic (2018). Self-injury/cutting. Retrieved from https://www.mayoclinic.org/diseases-conditions/self-injury/symptoms-causes/syc-20350950
544. Mayo Clinic (2018). Self-injury/cutting. Retrieved from https://www.mayoclinic.org/diseases-conditions/self-injury/symptoms-causes/syc-20350950
545. County Health Rankings & Roadmaps (n.d.). Drug overdose deaths [Data table]. Retrieved from https://www.countyhealthrankings.org/app/texas/2016/measure/factors/138/data
546. National Institute on Drug Abuse (2019). Electronic cigarettes (e-cigarettes). Retrieved from https://www.drugabuse.gov/publications/drugfacts/elec-

tronic-cigarettes-e-cigarettes
547. Chapman, S. L C. & Wu, L. (2014). E-cigarette prevalence and correlates of use among adolescents versus adults: A review and comparison. Journal of Psychiatric Research, 54, 43-54. https://doi.org/10.1016/j.jpsychires.2014.03.005
548. Texas Department of State Health Services (2019). Behavioral risk factor surveillance system (BRFSS) 2013-2017 [Data file]. Retrieved from https://dshs.texas.gov/chs/brfss/default.shtm
549. Hammond, D., Reid, J. L., Rynard, V. L., Fong, G. T., Cummings, M. K., McNeill, A., … et al. (2019). Prevalence of vaping and smoking among adolescents in Canada, England, and the United States: repeat national cross sectional surveys, The BMJ, 365(8204), 12219. https://doi.org/10.1136/bmj.l2219
550. Sleiman, M., Logue, J. M., Montesinos, V. N., Russel, M. L., Litter, M. I., Gundel, L. A., & Destaillats H. (2016). Emissions from electronic cigarettes: Key parameters affecting the release of harmful chemicals. Environmental Science Technology, 50(17). 9644-9651. https://doi.org/10.1021/acs.est.6b01741
551. American Cancer Society (2019). Known and probably human carcinogens. Retrieved from https://www.cancer.org/cancer/cancer-causes/general-info/known-and-probable-human-carcinogens.html
552. American Lung Association (2019). The impact of e-cigarettes on the lung. Retrieved from https://www.lung.org/stop-smoking/smoking-facts/impact-of-e-cigarettes-on-lung.html
553. National Academy of Sciences, Engineering, and Medicine (2018). Public health consequences of e-cigarettes. Washington, DC: The National Academies Press. http://doi.org/10.17226/24952
554. Centers for Disease Control and Prevention (2019). CDC, states investigating severe pulmonary disease among people who use e-cigarettes. CDC Newsroom. Retrieved from https://www.cdc.gov/media/releases/2019/s0817-pulmonary-disease-ecigarettes.html
555. Centers for Disease Control and Prevention (2019). Outbreak of lung injury associated with e-cigarette use, or vaping. Retrieved from https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html
556. The University of Texas School of Public Health. (2018). Health of Houston 2018 [Data file]. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/
557. Reidel, B., Radicioni, G., Clapp, P. W., Ford, A. A., Abdelwahab, S., Reguli, M. E., … et al. (2018). E-cigarette use causes a unique innate immune response in the lung, involving increased neutrophilic activation and altered mucin secretion. American Journal of Respiratory and Critical Care Medicine, 197(4). https://doi.org/10.1164/rccm.201708-1590OC
558. Centers for Disease Control and Prevention (2018). Intimate partner violence. Retrieved from https://www.cdc.gov/violenceprevention/intimatepartnerviolence/index.html
559. Centers for Disease Control and Prevention (2019). Intimate partner violence fast facts. Retrieved from https://www.cdc.gov/violenceprevention/intimatepartnerviolence/fastfact.html
560. Niolon, P. H., Kearns, M., Dills, J., Rambo, K., Irving, S., Armstead, T. L., & Gilbert L. (2017). Preventing intimate partner violence across the lifespan: A technical package of programs, policies, and practices. Division of Violence Prevention, National Center for Injury Prevention and Control, CDC. Retrieved from https://www.cdc.gov/violenceprevention/pdf/ipv-technicalpackages.pdf
561. Centers for Disease Control and Prevention (2019). Intimate partner violence fast facts. Retrieved from https://www.cdc.gov/violenceprevention/intimatepartnerviolence/fastfact.html
562. National Human Trafficking Hotline (n.d.). Texas. Retrieved from https://humantraffickinghotline.org/state/texas
563. Correa, N. P. (2018). An assessment of screening for intimate partner violence. Retrieved from https://www.texaschildrens.org/sites/default/files/uploads/IPV%20Assessment%20Final.pdf
564. Harris County Domestic Violence Coordinating Council (n.d.). Mission. Retrieved from https://www.hcdvcc.org/about/mission/
565. Injury Prevention Center, Strong Families (n.d.). Overcoming adverse childhood experiences: creating hope for a healthier Arizona. Retrieved from https://www.childhealthdata.org/docs/drc/arizona-aces-efinal.pdf
566. Centers for Disease Control and Prevention (2019). About ACEs. Retrieved from https://www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/aboutace.html
567. ACEs Too High (n.d.). ACEs science 101. Retrieved from https://acestoohigh.com/aces-101/
568. Fuller-Thomson, E., Sawyer J., & Agbeyaka, S. (2019). The toxic triad: Childhood exposure to parental domestic violence, parental addictions, and parental mental illness as factors associated with childhood physical abuse. Journal of Interpersonal Violence. https://doi.org/10.1177/0886260519853407
569. Data Resource Center for Child & Adolescent Health (n.d.). NSCH interactive data query (2016-2018) [Data query]. Retrieved from https://www.childhealthdata.org/browse/survey/results?q=5545&r=45
570. Centers for Disease Control and Prevention (2019). About ACEs. Retrieved from https://www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/aboutace.html
571. Harris County Department of Education (n.d.). CASE for Kids. Retrieved from https://hcde-texas.org/after-school/
572. Harris County Department of Education (n.d.). School-based therapy services. Retrieved from https://hcde-texas.org/school-therapy/
573. The Children's Assessment Center (n.d.). Our services. Retrieved from https://www.cachouston.org/our-services/
574. The Harris Center for Mental Health and IDD (n.d.). Our services. Retrieved from https://theharriscenter.org/
575. Texas Children's Hospital (n.d.). Child abuse pediatric team. Preventive Outreach and Education. Retrieved from https://www.texaschildrens.org/about-us/preventive-outreach/child-abuse-pediatric-team
576. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
577. Governors Highway Safety Association (n.d.). Pedes-

trian traffic fatalities by state: 2017 preliminary data. Retrieved from https://www.ghsa.org/resources/spotlight-pedestrians18
578. Begley, D. & Barned-Smith S. (n.d.). Out of control: Houston's roads, drivers are country's most deadly. Retrieved from https://www.houstonchronicle.com/news/investigations/article/Houston-s-roads-drivers-are-nation-s-most-12865072.php
579. Cummings, P. L., Schwaller, E., Wesely, S., & Choi, L. E. (2016). East Aldine district's town center development: A health impact assessment in Harris County, Texas. Harris County Public Health. Retrieved from https://www.pewtrusts.org/-/media/assets/external-sites/health-impact-project/east-aldine-hia.pdf?la=en&hash=0DA58E910BA805D-FBD833CCAACDD13DE0481100E
580. Centers for Disease Control and Prevention (2019). Preventing dog bites. CDC Features. Retrieved from https://www.cdc.gov/features/dog-bite-prevention/index.html
581. Centers for Disease Control and Prevention (1997). Dog-bite-related fatalities -- United States, 1995-1996. CDC Prevention Guidelines Database. Retrieved from https://wonder.cdc.gov/wonder/prevguid/m0047723/m0047723.asp
582. World Health Organization (n.d.). Falls. Retrieved from https://www.who.int/violence_injury_prevention/other_injury/falls/en/
583. Texas Department of State Health Services (2017). Texas inpatient discharge public use data file (PUDF) & Texas outpatient surgical and radiological procedure public use data file (PUDF) [Data files]. Texas Health Data Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
584. Houston State of Health (n.d.). Age-adjusted death rate due to falls. Retrieved from http://www.houstonstateofhealth.com/indicators/index/view?indicatorId=103&localeId=2675
585. Houston Health Department (2019). Expected high heat indices pose risk to groups particularly vulnerable to heat-related illnesses. Retrieved from https://www.houstontx.gov/health/NewsReleases/heat-20190607.html
586. Texas Department of State Health Services (2016-2018). Texas hospital emergency department public use data file (PUDF) [Data file]. Center for Health Statistics. Retrieved from https://www.dshs.texas.gov/thcic/OutpatientFacilities/Texas-Emergency-Department-Data/
587. Centers for Disease Control and Prevention (2017). About extreme heat. Retrieved from https://www.cdc.gov/disasters/extremeheat/heat_guide.html
588. Office of Disease Prevention and Health Promotion (2014). Maternal, infant, and child health. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Maternal-Infant-and-Child-Health/determinants
589. Ernst, H. & Stickler, T. (2018). Health risks associated with pregnancy. Retrieved from https://www.healthline.com/health/pregnancy/risk-factors
590. Yu, S. (2006). The life-course approach to health. American Journal of Public Health, 96(5): 768. doi: 10.2105/AJPH.2006.088617
591. Lifecourse Initiative for Healthy Families. (n.d.). Our approach. Retrieved from https://lihf.wisc.edu/about-us/our-approach/
592. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
593. World Health Organization (n.d.). Maternal mortality ratio (per 100 000 live births). Retrieved from https://www.who.int/healthinfo/statistics/indmaternalmortality/en/
594. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
595. Houston Endowment Fund (2018). Improving maternal health in Harris County: A community plan. Retrieved from https://www.houstonendowment.org/news/new-community-plan-offers-recommendations-to-improve-maternal-health-in-harris-county/
596. Houston Endowment Fund (2018). Improving maternal health in Harris County: A community plan. Retrieved from https://www.houstonendowment.org/news/new-community-plan-offers-recommendations-to-improve-maternal-health-in-harris-county/
597. Centers for Disease Control and Prevention (n.d.). Multiple cause of death data (1999-2017) [Data Query]. CDC WONDER. Retrieved from https://wonder.cdc.gov/mcd.html
598. Texas Health and Human Services (2018). Maternal mortality and morbidity task force and department of state health services joint biennial report. Retrieved from https://www.dshs.texas.gov/legislative/2018-Reports/MMMTFJointReport2018.pdf
599. Office of Disease Prevention and Health Promotion (2019). Maternal, infant, and child health. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives
600. Centers for Disease Control and Prevention (2018). Reproductive health: Infant mortality. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm
601. United Health Foundation (2018). American's Health Rankings. International Comparison. Retrieved from https://www.americashealthrankings.org/learn/reports/2018-annual-report/findings-international-comparison
602. Centers for Disease Control and Prevention (2018). Reproductive health: Infant mortality. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm
603. Elder, T. E., Goddeeris, J. H., & Haider, S. J. (2016). Racial and ethnic infant mortality gaps and the role of socio-economic status. Labour Economics, 43, 42-54. doi: 10.1016/j.labeco.2016.04.001
604. Centers for Disease Control and Prevention (2018). Reproductive health: Preterm birth. Retrieved from https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.htm
605. World Health Organization (2018). Preterm birth. Retrieved from https://www.who.int/news-room/fact-sheets/detail/preterm-birth
606. March of Dimes (2017). U.S. preterm birth rate on the rise for second year in a row. Retrieved from https://www.marchofdimes.org/news/u-s-preterm-birth-rate-on-the-rise-for-second-year-in-a-row.aspx
607. March of Dimes Perinatal Data Center (2014-2016).

PeriStats [Data center]. Retrieved from https://www.marchofdimes.org/peristats/Peristats.aspx
608. March of Dimes (2019). Peristats: Preterm birth. Retrieved from https://www.marchofdimes.org/Peristats/ViewSubtopic.aspx?reg=99&top=3&stop=362&lev=1&slev=1&obj=1
609. Smith, M., Miller, K. & Raetzman, S. (2018). The excess cost of premature or low birthweight births and complicated deliveries to Medicaid. IBM Watson Health. Retrieved from https://www.ibm.com/downloads/cas/WWDZPDL2
610. Bekemeier, B., Yang, Y., Dunbar, M., Pantazis, A., & Grembowski, D. (2014). Targeted health department expenditures benefit birth outcomes at the county level. American Journal of Preventive Medicine, 46(6), 569-577. doiL 10.1016/j.amepre.2014.01.023
611. March of Dimes (n.d.). Peristats. Retrieved from https://www.marchofdimes.org/peristats/Peristats.aspx
612. Texas Department of State Health Services (n.d.). Birth indicator data table builder [Data query]. Retrieved from http://healthdata.dshs.texas.gov/VitalStatistics/Birth
613. Texas Department of State Health Services (n.d.). Birth indicator data table builder [Data query]. Retrieved from http://healthdata.dshs.texas.gov/VitalStatistics/Birth
614. Texas Department of State Health Services (n.d.). Birth indicator data table builder [Data query]. Retrieved from http://healthdata.dshs.texas.gov/VitalStatistics/Birth
615. Wymelenberg, S. (1990). Prenatal care: Having healthy babies. Science and babies: Private decisions, public dilemmas. Washington (DC): National Academies Press (US). http://doi.org/10.17226/1453
616. Starbird, E., Norton, M., & Marcus, R. (2016). Investing in family planning: Key to achieving the sustainable development goals. Global Health Science Practice, 4(2), 191-210. doi: 10.9745/GHSP-D-15-00374
617. Galewitz, P. & Gorman, A. (2018). States extend Medicaid for birth control, cutting costs – And future enrollment. Washington Post. Retrieved from https://www.washingtonpost.com/national/health-science/states-extend-medicaid-for-birth-control-cutting-costs--and-future-enrollment/2018/03/22/89159df0-2db1-11e8-8dc9-3b51e028b845_story.html
618. Starbird, E., Norton, M., & Marcus, R. (2016). Investing in family planning: Key to achieving the sustainable development goals. Global Health Science Practice, 4(2), 191-210. doi: 10.9745/GHSP-D-15-00374
619. Centers for Disease Control and Prevention (2019). About breastfeeding. Retrieved from https://cdc.gov/breastfeeding/about-breastfeeding/index.html
620. Gartner, L. M., Morton, J., Lawrence, R. A., Naylor, A. J., O'Hare, D., Schanler, R. J., … et al. (2005). Breastfeeding and the use of human milk, Pediatrics, 115(2), 496–506. doi: 10.1542/peds.2004-2491
621. Dieterich, C. M., Felice, J. P., O'Sullivan, E., & Rasmussen, K. M. (2013). Breastfeeding and health outcomes for the mother-infant dyad. Pediatric Clinics of North America, 60(1), 31. doi: 10.1016/j.pcl.2012.09.010
622. US Department of Health & Human Services (2011). The Surgeon General's call to action to support breastfeeding. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK52684/
623. Office of Disease Prevention and Health Promotion (n.d.). Maternal, infant, and child health. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives
624. World Health Organization (2018). Adolescent pregnancy. Retrieved from https://www.who.int/news-room/fact-sheets/detail/adolescent-pregnancy
625. Office of Population Affairs. Texas adolescent reproductive health facts. Texas Department of Human and Health Services. Retrieved from https://www.hhs.gov/ash/oah/facts-and-stats/national-and-state-data-sheets/adolescent-reproductive-health/texas/index.html
626. Brazeal, J., Marra, L., McKerlie, K. & Faulkner, M. (2015). Mixed messages: The current state of teen pregnancy prevention in Travis County, TX. The Healthy Youth Partnership, Child and Family Research Institute. Retrieved from https://txicfw.socialwork.utexas.edu/wp-content/uploads/2015/08/HYP-Needs-Assessment_Final_web.pdf
627. National Campaign to Prevent Teen and Unplanned Pregnancy (2012). Why it matters: Teen childbearing, education, and economic wellbeing. Retrieved from https://rhyclearinghouse.acf.hhs.gov/library/2012/why-it-matters-teen-childbearing-education-and-economic-wellbeing
628. US Department of Health & Human Services (2019). 30 achievements in women's health in 30 years (1984-2014): Decrease in teen pregnancy. Office on Women's Health. Retrieved from https://www.womenshealth.gov/30-achievements/09
629. Alker, J. & Pham, O. (2018). Nation's progress on children's health coverage reverses course. Georgetown University Health Policy Institute Center for Children and Families. Retrieved from https://ccf.georgetown.edu/2018/11/21/nations-progress-on-childrens-health-coverage-reverses-course/
630. The University of Texas Health Science Center at Houston UTHealth School of Public Health (2019). Health of Houston survey 2017-18: A Brief Summary. Retrieved from https://sph.uth.edu/research/centers/ihp/health-of-houston-survey-2010/HHS2018%20final%20report_9-6-2019.pdf
631. Wherry, L. R., Kenney, G. M., & Sommers, B. D. (2016). The role of public health insurance in reducing child poverty. Academic Pediatrics, 16(3), S98-S104. doi: 10.1016/j.acap.2015.12.011
632. Courtenay, W. H. (2003). Key determinants of the health and well-being of men and boys. International Journal of Men's Health, 2(1), 1-30. Retrieved from http://www.postpartummen.com/pdfs/KEY-DTR.pdf
633. Roybal, E. R. (1989). The quality of life for older women: older women living alone - A report by the chairman of the select committee on aging. House of Representatives, One Hundredth Congress, Second Session (December 1988).
634. Center for Disease Control and Prevention (2019). Leading causes of death [Data report]. Retrieved

from https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm
635. Centers for Disease Control and Prevention (2019). Health equity: Males – 2016. Retrieved from https://www.cdc.gov/healthequity/lcod/men/2016/index.html
636. Brawley, O. W. (2012). Trends in prostate cancer in the United States. Journal of the National Cancer Institute Monographs, 2012(45), 152-156. doi: 10.1093/jncimonographs/lgs035
637. National Cancer Institute (2019). State cancer profiles. Retrieved from https://statecancerprofiles.cancer.gov/index.html
638. Schroder, F. H., Hugosson, J., & Roobol, M. J. (2009). Screening and prostate-cancer mortality in a randomized European study. New England Journal of Medicine. 360(13), 1320-1328. doi: 10.1056/NEJMoa0810084
639. Office of Disease Prevention and Health Promotion (2019). Disability and health. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/disability-and-health
640. Centers for Disease Control and Prevention (2019). Disability impacts all of us. Retrieved from https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html#text-version
641. National Association of County & City Health Officials (2018). Follow-up national assessment of the practices, awareness, and inclusion of people with disabilities in local health departments public health practices. Retrieved from https://www.naccho.org/uploads/downloadable-resources/Health-and-Disability-Followup-Assessment-Report_June-2018_FINAL.pdf
642. City of Houston (2017). A ten year plan for the city of Houston: A plan for fiscal sustainability and economic growth. Retrieved from http://www.houstontx.gov/finance/COH-Ten-Year-Plan-Report.pdf
643. Centers for Disease Control and Prevention (2018). One Health basics. Retrieved from https://www.cdc.gov/onehealth/basics/index.html
644. City of Houston (2017). A ten-year plan for the City of Houston: A plan for fiscal sustainability and economic growth. Retrieved from http://www.houstontx.gov/finance/COH-Ten-Year-Plan-Report.pdf
645. Brooks, H. L., Rushton, K., Lovell, K., Bee, P., Walker, L., Grant, L., & Rogers, A. (2018). The power of support from companion animals for people living with mental health problems: a systematic review and narrative synthesis of the evidence. BMC Psychiatry, 18(31). doi: 10.1186/s12888-018-1613-2
646. Centers for Disease Control and Prevention (2017). Zoonotic diseases. Retrieved from https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html
647. Centers for Disease Control and Prevention (2017). Zoonotic diseases. Retrieved from https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html
648. Takayama, N. (2008). Rabies: a preventable but incurable disease. Journal of Infection and Chemotherapy, 14(1), 8-14. doi: 10.1007/s10156-007-0573-0
649. Ma, X., Monroe, B. P., Cleaton, J. M., Orciari, L. A., Yu, L., Kirby, J. D., … et al. (2018). Rabies surveillance in the United States during 2017. Journal of the American Veterinary Medical Association, 253(12). Retrieved from https://avmajournals.avma.org/doi/pdfplus/10.2460/javma.253.12.1555
650. Texas Department of State Health Services (n.d.). Rabies surveillance in Texas [2018 summary report]. Retrieved from https://www.dshs.texas.gov/idcu/disease/rabies/cases/statistics/
651. World Health Organization (2018). 10 facts on tuberculosis. Retrieved from https://www.who.int/features/factfiles/tuberculosis/en/
652. Centers for Disease Control and Prevention (2018). CDC releases updated recommendations for treatment of latent TB infection. National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. Retrieved from https://www.cdc.gov/nchhstp/newsroom/2018/treatment-of-latent-TB-infection.html
653. Centers for Disease Control and Prevention (2019). HIV fast facts. Retrieved from https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics
654. Texas Department of State Health Services (2018). Texas HIV surveillance report: 2017 annual report. Retrieved from https://dshs.texas.gov/hivstd/reports/HIVSurveillanceReport.pdf
655. Ryan White Grant Administration (n.d.). Centralized patient care data management system. Retrieved from http://publichealth.harriscountytx.gov/Services-Programs/Programs/RyanWhite/CPCDMS
656. Texas Department of State Health Services (2018). Texas HIV surveillance report: 2017 annual report. Retrieved from https://dshs.texas.gov/hivstd/reports/HIVSurveillanceReport.pdf
657. Centers for Disease Control and Prevention (2019). New CDC report: STDs continue to rise in the US. NCHHSTP Newsroom. Retrieved from https://www.cdc.gov/nchhstp/newsroom/2019/2018-STD-surveillance-report-press-release.html
658. Centers for Disease Control and Prevention (2019). 2018 STD surveillance report highlights alarming threat: Newborn deaths from syphilis. Retrieved from https://www.cdc.gov/std/stats18/default.htm
659. Centers for Disease Control and Prevention (2019). The state of STDs in the United States. Retrieved from https://www.cdc.gov/std/stats18/national-2018.pdf
660. Centers for Disease Control and Prevention (n.d.). Reported STDs in the United States, 2018. Retrieved from https://www.cdc.gov/nchhstp/newsroom/docs/factsheets/std-trends-508.pdf
661. Centers for Disease Control and Prevention (2016). Gonorrhea detailed fact sheet. Retrieved from https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm
662. Texas Department of State Health Services (2018). Texas STD surveillance report. Retrieved from https://www.dshs.texas.gov/hivstd/reports/STD-SurveillanceReport.pdf
663. City of Houston (2017). A ten year plan for the city of Houston: A plan for fiscal sustainability and economic growth. Retrieved from http://www.houstontx.gov/finance/COH-Ten-Year-Plan-Report.pdf
664. Lightbourne, J. E. (2017). Consolidation or collabora-

tion? Common solutions to reduce overlapping services in local government. Rice University Kinder Institute for Urban Research. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Consolidation%20or%20Collaboration%20.pdf
665. Centers for Disease Control and Prevention (2018). Estimates of foodborne illness in the United States. Retrieved from https://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html
666. Houston Health Department (n.d.). Epidemiology n review 2005-2014: A review of surveillance of notifiable conditions. Retrieved from http://www.houstontx.gov/health/Epidemiology/Documents/EIR_Online_PDF_FINAL_Part1.pdf
667. Rice University Kinder Institute for Urban Research (2018). Governing a growing region: Addressing challenges of service provision and development in Houston [PDF document]. Retrieved from https://kinder.rice.edu/sites/g/files/bxs1676/f/documents/Governing%20A%20Growing%20Region.pdf
668. Memorial Sloan Kettering Cancer Center (n.d.). Multidrug resistant organisms (MDROs). Retrieved from https://www.mskcc.org/cancer-care/patient-education/multidrug-resistant-organisms-mdros
669. World Health Organization (2018). Antibiotic resistance. Retrieved from https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance
670. Centers for Disease Control and Prevention (2013). Antibiotic resistance threats in the United States, 2013. Retrieved from https://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf
671. Haque, M., Sartelli, M., McKimm, J., & Abu Bakar, M. (2018). Health care-associated infections - an overview. Infection and Drug Resistance, 11, 2321–2333. doi:10.2147/IDR.S177247
672. Roberts, R. R., Hota, B., Ahmad, I., Scott, R. D. 2nd, Foster, S. D., Abassi, F., … et al. (2009). Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: Implications for antibiotic stewardship. Clinical Infectious Diseases, 49(8), 1175–1184. doi: 10.1086/605630
673. The White House (2015). National action plan for combating antibiotic-resistant bacteria. Retrieved from https://www.cdc.gov/drugresistance/pdf/national_action_plan_for_combating_antibotic-resistant_bacteria.pdf
674. Centers for Disease Control and Prevention (2019). Lab capacity: Antibiotic resistance laboratory network (AR lab network). National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Healthcare Quality Promotion (DHQP). Retrieved from https://www.cdc.gov/drugresistance/solutions-initiative/ar-lab-network.html#anchor_1536327306157
675. World Health Organization (2018). Sepsis. Retrieved form. https://www.who.int/news-room/fact-sheets/detail/sepsis
676. Centers for Disease Control and Prevention and Disease (2016). Data and reports. Retrieved from https://www.cdc.gov/sepsis/datareports/index.html
677. Kempker, J. A., Wang, H. E., & Martin, G. S. (2018). Sepsis is a preventable public health problem. Critical Care, 22(1), 116.
678. Dantes, R. B., & Epstein, L. (2018). Combatting sepsis: a public health perspective. Clinical Infectious Diseases, 67(8), 1300-1302.
679. Centers for Disease Control and Prevention (2019). Reported cases and deaths from vaccine-preventable diseases, United States. National Center for Emerging and Zoonotic Infectious Diseases (NCEZID). Retrieved from https://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/E/reported-cases.pdf
680. Centers for Disease Control and Prevention (2018). History of measles. Retrieved from https://www.cdc.gov/measles/about/history.html
681. Office of Disease Prevention and Health Promotion (2019). Immunization and infectious diseases. HealthyPeople2020. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases#star
682. Texas Health & Safety Code Sec. 161.004 (d)(1)
683. Texas Health & Human Services. (2019). Percent of students with conscientious exemptions filed by county and school year – Texas annual report of immunization status, Kindergarten through 12th grade. Retrieved from https://www.dshs.texas.gov/uploadedFiles/Content/Prevention_and_Preparedness/immunize/coverage/schools/Exemptions%20by%20County%202010-2018.pdf
684. Texas Department of State Health Services (2019). Vaccination coverage levels in Texas schools. Retrieved from https://www.dshs.texas.gov/immunize/coverage/schools/
685. Hotez, P. J. (2016). Texas and its measles epidemics. PLoS Medicine, 13(10), e1002153. doi: 10.1371/journal.pmed.1002153
686. Lo, N. C. & Hotez, P. J. (2017). Public health and economic consequences of vaccine hesitancy for measles in the United States. JAMA Pediatrics, 171(9), 887-892. doi: 10.1001/jamapediatrics.2017.1695
687. Lo, N. C. & Hotez, P. J. (2017). Public health and economic consequences of vaccine hesitancy for measles in the United States. JAMA Pediatrics, 171(9), 887-892. doi: 10.1001/jamapediatrics.2017.1695
688. Houston Health Department (n.d.). Immunization information for parents. Retrieved from https://www.houstontx.gov/health/Immunizations/information_for_parents.html
689. North Carolina Department of Health & Human Services (2019). Infectious respiratory diseases. Retrieved from https://epi.dph.ncdhhs.gov/cd/diseases/respiratory.html
690. Centers for Disease Control and Prevention (2019). Group B Strep (GBS). National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from https://www.cdc.gov/groupbstrep/about/prevention.html
691. Texas Health & Human Services (2019). Streptococcus pneumoniae. Retrieved from https://dshs.texas.gov/idcu/disease/strep/spneumo/
692. Centers for Disease Control and Prevention (2017). Pneumococcal disease. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from https://www.cdc.gov/pneumococcal/about/index.html
693. Centers for Disease Control and Prevention (2017). Pneumococcal disease: Fast facts. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from

https://www.cdc.gov/pneumococcal/about/facts.html
694. Centers for Disease Control and Prevention (2018). Legionella (Legionnaires' disease and pontiac fever). National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from https://www.cdc.gov/legionella/index.html
695. North Carolina Department of Health & Human Services. (2018). Legionellosis. Retrieved from https://epi.dph.ncdhhs.gov/cd/diseases/legionellosis.html
696. Centers for Disease Control and Prevention (2018). Legionella history, burden, and trends. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from https://www.cdc.gov/legionella/about/history.html
697. Texas Department of State Health Services (2019). Data (Legionnaire's disease). Retrieved from https://www.dshs.texas.gov/IDCU/disease/legionnaires/Data.aspx
698. Office of Disease Prevention and Health Promotion (n.d.). Immunization and infectious diseases. Healthy People. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases
699. Centers for Disease Control and Prevention (2018). Key facts about influenza - flu. National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from https://www.cdc.gov/legionella/about/history.html
700. Centers for Disease Control and Prevention (2018). Estimated influenza illnesses, medical visits, hospitalizations, and deaths in the United States – 2017-2018 influenza season. Retrieved from https://www.cdc.gov/flu/about/burden/2017-2018.htm
701. Texas Health & Human Services (2019). Influenza associated pediatric mortality data. Retrieved from https://www.dshs.state.tx.us/IDCU/disease/IAPM/Influenza-Associated-Pediatric-Mortality-Data.aspx
702. Centers for Disease Control and Prevention (2018). Study shows flu vaccine reduces risk of severe illness. Retrieved from https://www.cdc.gov/flu/spotlights/2017-2018/vaccine-reduces-risk-severe-illness.htm
703. World Health Organization (n.d.). About vector-borne diseases. Retrieved from https://www.who.int/campaigns/world-health-day/2014/vector-borne-diseases/en/
704. Centers for Disease Control and Prevention (2018). Illnesses on the rise. National Center for Emerging and Zoonotic Infectious Diseases. https://www.cdc.gov/vitalsigns/vector-borne/
705. Climate Nexus (n.d.). Climate Risk and Spread of Vector-Borne Diseases. Retrieved from https://climatenexus.org/climate-issues/health/climate-change-and-vector-borne-diseases/
706. Barney, C. E. (2008). Dengue risk factor distribution in Harris County, Texas. Texas Medical Center Dissertations (via ProQuest). Retrieved from https://digitalcommons.library.tmc.edu/dissertations/AAI1454489
707. Texas Department of State Health Services (2019). Flea-borne typhus. Retrieved from https://dshs.texas.gov/idcu/disease/murine_typhus/
708. Centers for Disease Control and Prevention (2019). Ticks – On people. Retrieved from https://www.cdc.gov/ticks/avoid/on_people.html
709. World Health Organization (n.d.). Integrated vector management (IVM). Retrieved from https://www.who.int/neglected_diseases/vector_ecology/ivm_concept/en/
710. Centers for Disease Control and prevention (2018). Ebola (Ebola virus disease) signs and symptoms. Retrieved from http://www.cdc.gov/vhf/ebola/symptoms/
711. World Health Organization (n.d.). Ebola virus disease. Retrieved from http://www.who.int/health-topics/ebola/#tab=tab_1
712. World Health Organization (n.d.). As Ebola cases reach 3000 in DRC, WHO calls on all partners to fulfill promises to communities. Retrieved from http://www.who.int/news-room/detail/29-08-2019-as-ebola-cases-reach-3000-in-drc-who-calls-on-partners-to-fulfill-promises-to-communities
713. Robert Wood Johnson Foundation (n.d.). Global ideas for US solutions: Learning from abroad to improve health and well-being in the United States. Retrieved from https://www.rwjf.org/en/how-we-work/grants-explorer/featured-programs/global-learning.html
714. Council of State and Territorial Epidemiologists (2017). Big cities health coalition epidemiology capacity assessment, 2017. Retrieved from https://cdn.ymaws.com/www.cste.org/resource/resmgr/eca/BCHA_ECA_WEB.pdf